THE ELECTRICAL WORLD

A Weekly Review of Current Electricity and Its Applications

PUBLISHED EVERY SATURDAY

AT NO. 9 MURRAY STREET, NEW YORK.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

New England Office, 48 Congress Street, Boston.
Western Office, 23 Borden Block, Chicago.

W. J. JOHNSTON, Editor and Publisher.

T. COMMERFORD MARTIN, JOSEPH WETZLER, Associate Editors.

E. P. THOMPSON, Associate Editor Patent Department.

CLARENCE E. STUMP, Business Manager.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.

(Postage Prepaid in the U. S. or Canada.)

CLUBS.—In clubs of 4 or more, $2.50 a year each; with a free extra copy to the getter-up of a club of 8. Subscription to foreign countries, $4 a year.

In requesting your address changed, give **old** as well as new address.

THE ELECTRICAL WORLD

HAS THE LARGEST CIRCULATION

OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS

THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions.

Notices of Situations or Help Wanted, $1 to $3 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to

The Editor of The Electrical World, New York.

Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed

W. J. JOHNSTON, Publisher,

No. 9 Murray Street, New York,

OR EITHER OF THE BRANCH OFFICES.

CONTENTS.

ILLUSTRATED ARTICLES:	PAGE.
Galvanometer and Accessories	2
"Western Electric" Combination Set	3
Siphon Recorder Used on The Mackay-Bennett Cables	3
The Iceberg Electric Fan and a New Battery Jar	4
Analytical Balances	5
CORRESPONDENCE:	
A Few Powerful Lamps	8
Put Arc Lamps at the Top and Bottom	8
Incandescent Lamps Required	8
Telephonic Interrogatories	8
The Jenney Companies	8
EDITORIAL PARAGRAPHS	1
Much Ado About Nothing	1
MISCELLANEOUS:	
The Peruvian Electrical Construction and Supply Company	2
An Operator for Public Printer	2
Death of Prof. Fleeming Jenkin	2

MISCELLANEOUS:	PAGE.
A Foreign Criticism of Western Union	2
Electricity or Gas—Which?	3
Long Branch Telegraph Offices	3
Reunion of Old Telegraphers	4
The Bankers & Merchants' Company Reorganized	4
Relative Cost of Overhead and Underground Wires	4
The Cruto Incandescent Lamp	4
Mackenzie's Indicator	5
Incandescent Lighting by Primary Battery	5
Static Electricity. Chap. III., concluded	6
Secondary Batteries	7
DEPARTMENTS:	
New England Notes	8
Western Notes	8
The Telegraph	9
The Telephone	9
The Electric Light	9
Miscellaneous Notes	9
Stock Quotations	9
Business Notices	9
Our Illustrated Record of Electrical Patents	10

New Advertisements.

Stout, Meadowcroft & Co.—Electric Fan ... i & iii
The Warren P. Freeman Co.—Electric Light Outfits ... i
A. L. Bogart—The Bartholdi and Polaristic Automatic Electric Burners ... v
Redding Electrical Co.—Electrical Supplies ... vi
Forest City Electric Works, Cleveland—Electric Cut-Out ... vi
Seth W. Fuller & Holtzer—Leclanché "Disque" Battery ... vii
Box 294—Position Wanted ... x
National Electric Light Association—Special Notice ... x

Vol. VI. NEW YORK, JULY 4, 1885. No. 1.

WE have received some more subscriptions to the Bartholdi Pedestal Fund. The amount received up to date by the New York *World*, to whose fund our own is subsidiary, reaches $90,000; and as it is desired to get in the whole $100,000 as quickly as possible, we trust that all who have returns to make will do so promptly. Acknowledgement will be made next week of the sums received so far.

WE find that there is a growing interest in the subject of secondary batteries. All that we publish is read with interest, and we are met every week with the inquiry and request for more. Last week we gave an article on charging secondary batteries, by Mr. W. H. Preece; this week we give another admirable article, covering the whole ground, by Mr. Frank Geere Howard. It is an excellent addition to the scant literature of this department of electrical science.

COMPLAINTS are now being made in some parts of England about the high rates of telephone subscription. We cannot ourselves see that the rates are very high. The London *Electrical Review* meets the criticisms in a sensible and logical article, pointing out that the rates in England are lower than in America or France, and that they must of necessity increase in keeping with the increase in the facilities provided by the larger exchanges, whose expenses are much heavier than those of small exchanges. It deprecates any pressure for lower rates now and advises that the service be rendered as efficient as possible, so as to be worth what is charged for it.

THE three Electrical Subway Commissioners who are to discharge the highly responsible and important work of putting the wires underground in this city have at last been selected. On July 1 Mayor Grace nominated Prof. Charles F. Chandler, Mr. Frank L. Pope and Mr. John P. Townsend, all well-known and able men. He was outvoted, however, by Controller Loew and Commissioner of Works Squire, who were associated with him in making the choice, and who selected Messrs. Charles E. Loew, Jacob Hess and Theodore Moss. Mr. Loew is the brother of the Controller, Mr. Hess is a butcher and a Republican "machine" politician, and Mr. Theodore Moss is the treasurer of Wallack's Theatre. These gentlemen are given full discretionary powers in regard to burying the wires, and are to report within two years. During that time they will receive $5,000 a year each for their services, to be paid by the electrical companies using wires in New York.

WE print to-day some communications in regard to the manner of lighting the Bartholdi Statue. Two of our correspondents suggest plans which commend themselves in certain particulars, but it must be borne in mind that the question of cost must also be included in the calculation. To light the statue well, at the smallest expense, means as few lamps as possible, and these distributed in the most advantageous positions. The *uniform illumination* which one of our correspondents emphasizes should undoubtedly be secured as nearly as possible, for obvious reasons. The proposition of lighting the statue by incandescent lamps will, no doubt, provoke a smile in many of our readers. The writer of the communication has evidently forgotten how large a number of lamps would be required to produce an adequate illumination; not to speak of the power required to run them. As regards his criticisms concerning the disturbing effects of vibration in the action of the arc lamps, it remains to be seen whether the trouble will be of such magnitude as to impair the efficient working of the lamps. There are numerous forms of arc lamps which can be subjected to quite violent vibrations without disturbing their proper function, so that even in the most unfavorable emergency there would be no obstacle to the employment of the arc light. The subject is still open for discussion, and can well bear it in view of its importance.

A CASE has just been decided in the Circuit Court at Charleston, S. C., in which it was shown that even a telephone exchange has some rights that must be respected. Action was brought for $5,000 damages against the Southern Bell Telephone Company by a subscriber whose wire had been cut because he persisted in allowing non-subscribers to use his instrument. The verdict was for $1 and costs. The judge charged the jury that under the contract the plaintiff had no right to allow non-subscribers to use his telephone, but the company had no right to cut his wire until it had forbidden such a practice in writing. If the offense continued after such a notice, the company had the right to cut the wire, but if not continued it had no right to do so upon a mere threat of the plaintiff that he would continue to violate the contract. The idea is rather amusing, that after insisting, at the start, that there shall be no "dead-head" use of the instrument, and after repeated warnings against such use, the company must forbid the practice in writing. We would like to know how this method of enforcing his rights would suit a livery-stable keeper who had hired out a carriage and horse to a private gentleman for the day, and then found that they were being employed without intermission in conveying large numbers of riotous excursionists all over the city.

THAT subtle agent, ozone, to which Schoenbein first drew attention, has been the subject of great discussion, more in relation to its composition, however, than to its useful properties, although the latter have by no means been neglected. At the last meeting of the New York Electrical Society, Prof. Vander Weyde, during the course of a most interesting lecture on ozone, laid great stress on its well-known disinfecting properties. Its generation by electricity is easily accomplished, and we believe that in the near future the electrical product will occupy a prominent position in the sanitary field. It has been conclusively proven that virulent epidemics have been coexistent with a lack of ozone in the atmosphere, and a celebrated physician has put upon record the fact that a cholera epidemic ceased at the end of a severe thunder storm, the lightning having resupplied the air with ozone, which before the storm had been entirely wanting. In hospitals, also, artificially generated ozone has decreased the death rate in a marked manner, leaving little doubt as to cause. A small static electric machine is all that is required for generation, and, the efficacy of the ozone being acknowledged, there appears to be no good reason why it should not be largely employed as a disinfectant. It is certainly one of the most convenient and one of the most agreeable agents which can be employed, and the machine needs only to be operated a short time at long intervals to replenish the supply of ozone. We may remark in this connection that steps have already been undertaken to put the process on a practical footing, several private dwellings, hospitals and a stock exchange in this city having been recently supplied with ozone machines with marked beneficial effect. Thus, electricity advances every day, not only ministering to our wants and conducing to our comforts, but affording us a prophylactic against disease.

ONE point brought out very clearly in the interesting discussion printed in these columns on June 20, as to the protection of electrical inventions, was the importance to the inventor of the services of a good attorney; and that point shall be our excuse, if any is needed, for remarking that it has been the special aim of the Patent Agency connected with this publication office, to give that desirable help to inventive genius. At an early day, one of the ways in which recognition of our work in THE ELECTRICAL WORLD was manifested was the frequent application to us for advice and information in regard to patents; and the natural outcome was the establishment of the Agency, which now, in addition to a large home connection, has clients in China, Germany, England and other countries. Some idea of the extent of the work done may be formed when we state that during the last three or four months no fewer than nineteen foreign inventions have been patented through the Agency, while several other foreign cases are now in hand. To secure greater dispatch in this class of work, we have on some occasions used the cable, our special cable address enabling our foreign correspondents to reply to questions with promptitude and economy. As regards business originating in this country, we may say that it is already large and is rapidly increasing. Clients are particularly pleased with the construction of the claims upon which the value of the patent so greatly depends. In one case a patent was secured for a dynamo armature on which ten original claims were allowed on first examination and none rejected. So many rejected and abandoned cases have been brought to the Agency that a special feature has been made of that class, and in one case soon to be prosecuted, the application for a patent was filed eleven years ago, and was then thrice rejected. In the interval, a well-known firm has availed itself of the invention. In some cases, through the proper sub-division of labor, the agency has received the statement of an invention, has prepared the drawing and specification, and has mailed all the necessary documents to Washington on the same day. And here a word should be said for the present working of the Patent Office. In one case, recently, action was reported in four days; in another, within six days; and in another, within a couple of weeks. If this be due to Democratic administration, it is only fair that credit should be given it for such admirable celerity in a department where all the causes have hitherto operated to delay business and prevent inventors from benefiting quickly from the work of their brains.

MUCH ADO ABOUT NOTHING.

One of the brightest of the New York evening papers has wrought itself into a high state of excitement over an alleged impending danger to the great Bartholdi Statue of Liberty, which is soon to be erected on an island in New York harbor. Our contemporary is fearful lest electric action shall take place between the copper of the statue proper and the steel bracing within, and lest it will so weaken the statue as to cause its deterioration and final collapse. Several "interviews" with prominent electricians appear, to our contemporary, to confirm its belief in the eventual destruction of the statue, but in reality all the statements made by those gentlemen go to show the direct opposite to be the case.

As long as the points of junction of the two metals are kept free from moisture no injurious action can possibly take place, and the adoption of the usual method employed in such cases—*i. e.*, a good coating of paint, will effectually prevent or remove all danger. This appears so obvious that it seems almost superfluous to make mention of it, in the face of the fact that all iron or steel structures subjected to the influence of moisture are treated in the same way, for the purpose of preventing what might be called local electric action, causing the formation of rust. We may simply add that if the exposed Brooklyn Bridge can be protected from this injurious action, surely the sheltered bracing within the great statue can be, the presence of the copper being, in itself, no bar to that end. Our esteemed evening contemporary is being misled in this matter. We do not by any means deprecate the vigilance it shows, but in this instance its wonted public spirit is at fault.

The Peruvian Electrical Construction and Supply Company.

This new enterprise was recently formed, as stated in our columns last week, by gentlemen in the neighborhood of Boston, for the purpose of supplying the electric apparatus of the Thomson-Houston make to Peru. This company will operate under exclusive grants from the Peruvian government for a period of 20 years, and all their goods will be admitted through the ports of that country free of duty. These grants extend to and include the eight principal cities, viz., Lima, Callao, Arequipa, Puno, Cuzco, Truzillo, Cazamara and Puira.

Early in the present month, a plant of 90 arc lights, now being finished at the works of the Thomson-Houston Company, at Lynn, Mass., will be shipped to Peru. They will also ship two 50 h.-p. Armington & Sims' engines, and two Hennessy's steel tubular boilers, manufactured by Mr. R. F. Hawkins, of Springfield, Mass. They are determined to make this plant a success in every respect, and their aim will be to erect and furnish one of the finest electric lighting stations ever installed. They will use iron lamp-posts entirely. They have already received orders for apparatus from other cities and towns in Peru, but the grants under which they operate stipulate that they shall first introduce the lights into Lima, the capital.

Lima paid $124,000 last year for lighting the streets by gas and $24,000 additional for lighting the palace and administration buildings. In addition to this, private consumers used nearly 28,000,000 cubic feet of gas last year, paying for it $3.20 in gold per 1,000 feet. It will take about 360 arc lights for lighting the streets of Lima, and they will be set up as rapidly as possible.

The Peruvian government has expressed its willingness to pay at least as much for electric light as it has been paying heretofore for gas, which is of very inferior quality.

This company will enjoy great advantages in conducting their business in Peru, as owing to the exclusive nature of their franchises they enjoy perfect freedom, and practically own the territory mentioned above, for electric lighting. The great assurance, however, which they have for success, lies in the enormous cost of fuel. Take, for instance, the city of Arequipa. This city is located some distance inland, and freight alone on coal from the seaboard amounts to $16 per ton; making cost, delivered, $27 per ton. Some few years ago, a gas company was started at Arequipa, which invested two hundred thousand pounds sterling in a plant; but at $7 a thousand feet they could not pay expenses, and were compelled to abandon the enterprise and, of course, at a total loss. Since then the city has been lighted entirely by oil.

For electric lighting purposes ample water power exists in and near Arequipa, and it can be obtained at a mere nominal cost. So it will be readily seen that electric lights can be furnished at a very reasonable cost, underselling gas, and still yield a fair profit to the producers.

These favorable conditions exist in nearly all the other cities; and this, taking into consideration the great demand for electric lights which has been already created, justifies the supposition that the Peruvian Electrical Construction and Supply Company have inaugurated a profitable enterprise on the western slope of South America.

The Thomson-Houston system of both arc and incandescent lights will be used exclusiveiy in all installations made by this company.

The officers of the company are: President, C. A. Coffin; Vice-President, S. A. Barton; Secretary and Treasurer, Wm. Whitney Munroe. Peruvian Managers: William Widlund and Macario Llaguno. Directors: C. A. Coffin, Lynn, Mass.; S. A. Barton, Lynn, Mass; Wm. Whitney Munroe, Boston, Mass.; H. D. Stanley, Bridgeport, Conn.; R. F. Hawkins, Springfield, Mass.; William Widlund, Callao, Peru; A. F. Upton, Boston, Mass.

An Operator for Public Printer.

It was rumored last week that Mr. James Elverson, the well-known ex-operator, had been offered the position of Public Printer at Washington. The Government Printing Office is an immense establishment, employing something like three thousand men. A dispatch from Washington says that the President has been anxious for some time to have it overhauled and placed on a thorough business footing. He would probably have intrusted this task to his friend McCune, of Buffalo, had not death put a stop to an appointment in that quarter. Mr. Elverson is every way fitted for the work. He is a man of nearly fifty years of age, and the head of a great publishing house. Starting life in Newark, N. J., as a messenger boy, he learned to telegraph, and when the war broke out was stationed in Washington. With Robert E. Davis he went to Philadelphia in 1864 and began the publication of *Saturday Night*. The paper became a great success and brought in an immense revenue. The publication of the *Golden Days* was begun a few years ago. Mr. Davis withdrew from the firm with an independent fortune some years back and afterward started the *Evening Call* in Philadelphia, and Mr. Elverson is now the sole proprietor of his publications. It may interest the younger generation of operators to know that Mr. Elverson, who has toiled years and years at the key, is now building one of the finest residences in Washington, on Georgetown Heights. The mansion will cost about $125,000.

Galvanometer and Accessories.

Among the instruments employed at the Naval Observatory at Washington, is the Helmholtz-Gaugain galvanometer, shown in the accompanying illustration, Fig. 1. The instrument has two sets of coils. The fine wire coils consist of No. 26 gauge double silk-covered wire, and the large coils of No. 8 triple covered. The former are wound in 16 layers of 15 turns each, while the latter have 2 layers of 2 turns each.

The instrument is made by the Electric Manufacturing Company, of Troy, N. Y., whose handy testing set we described in our last issue. We give illustrations of several other instruments from among a large number made by them. Fig. 2 is a double successive contact key, used in

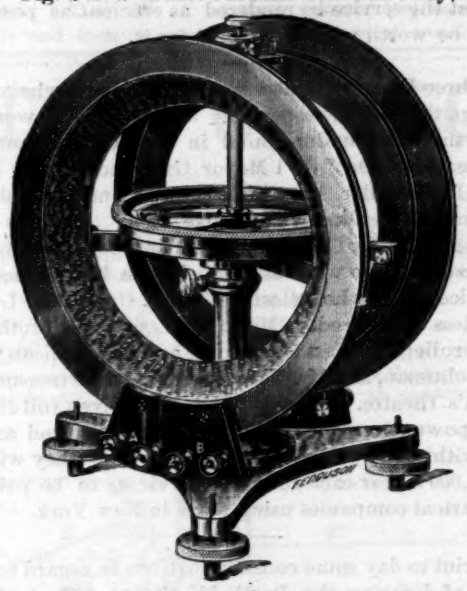


FIG. 1.—GAUGAIN GALVANOMETER.

connection with the Wheatstone bridge. This allows the battery circuit to be closed before the galvanometer circuit, and thus avoids the disturbing effect of the extra current, which would otherwise ensue.

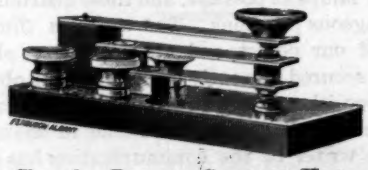


FIG. 2.—DOUBLE CONTACT KEY.

It is often necessary to reverse two circuits, and to perform this quickly and to obtain a good electric contact, the mercury commutator, Fig. 3, has been designed. The terminals of the circuits are connected to the respective

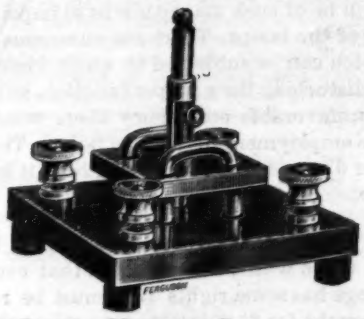


FIG. 3.—MERCURY COMMUTATOR.

diagonally opposite binding posts, the latter being connected to four troughs filled with mercury. A small rubber plate carrying two bent copper rods slides on a vertical bar, the ends of the rods dipping into the mercury.

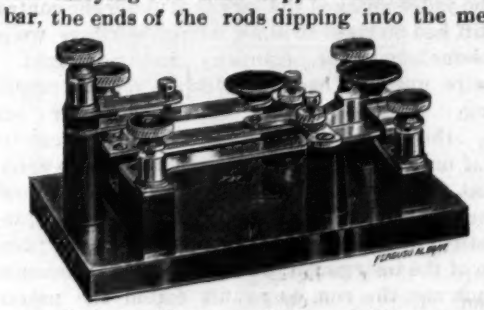


FIG. 4.—KEY FOR CAPACITY TESTS.

By raising the plate, and turning it 90°, the rods, when lowered, will make connections so that the reversal is accomplished. A small screw on the upright bar limits the movement, so that the reversal is made with very little trouble.

The illustration, Fig. 4, represents Lambert's key used in connection with Thomson's method of testing electrostatic capacity. The two buttons shown permit of the charging of a condenser and of the body to be tested, the mixing of the charges, and their final discharge through a galvanometer.

Death of Prof. Fleeming Jenkin.

It is with extreme regret that we announce the death of Prof. Fleeming Jenkin, which occurred on Friday, the 12th ult., and was caused by blood poisoning. When 13 years of age Mr. Jenkin was sent to a school at Frankfort-on-the-Main, and, a year later, to Paris, where he remained during the Revolution of 1848. Attending the University of Genoa subsequently to this, he there obtained the M. A. degree. In 1850 he commenced that engineering career which has since brought him so much distinction, his first experiences being gained in a locomotive shop at Marseilles. The following year he returned to England and was apprenticed for three years at Sir W. Fairbairn's famous works in Manchester. He soon rose to honorable employments, his first important step being an engagement with Messrs. Newall, of Birkenhead, with whom, in the year 1857, he was engaged in making preparations for laying the first Atlantic submarine telegraph cable. This circumstance was the means of bringing him into close relationship with Prof. (now Sir) William Thomson, with whom there was soon formed a life-long professional and intimate personal friendship, and from that gentleman he received much help and stimulus in his early professional career. Mr. Jenkin was successively engaged in the work of manufacturing not only the first Atlantic cable, but also the Red Sea cable, a cable extending from Singapore to Batavia, and several of the most important Mediterranean cables. He accompanied some of the expeditions for the laying of the latter. In the year 1861 he set up in business in London as a civil engineer on his own account, in partnership with Mr. H. C. Forde. Acting under the encouragement received from Sir William Thomson, he now began to write on scientific subjects, one of his earliest memoirs being a paper on "The Transmission of Signals through Submarine Cables," which was communicated to the Royal Society in 1862, and subsequently published in the *Philosophical Transactions*. On the motion of Sir William Thomson, a committee was named at the Manchester meeting of the British Association, held in 1861, for the determination of electrical standards. Mr. Jenkin was named as the reporter for that committee, and he was closely associated with Clerk Maxwell and other able experimental investigators in carrying out the work of the committee. For many years he recorded the work of the Electrical Standards Committee, and most of it was practically ratified at the International Conference of Electricians, held in Paris in 1883-84.

In 1866 Mr. Jenkin (who was now a Fellow of the Royal Society, at the age of 32 years) was elected to the Professorship of Engineering in University College, London. In that capacity he did such excellent work that he was fixed upon as the first occupant of a similar chair founded in the University of Edinburgh in the year 1868. He readily accepted of the appointment when it was offered to him, and forthwith relinquished his London partnership with Mr. Forde. Being within easy reach of Glasgow, he had much professional intercourse with Sir William Thomson, and as a result of that intercourse, as also with Mr. C. F. Varley and others, very much progress was made in the improvement of signaling apparatus for long submarine cables. He and Sir William Thomson were engaged as consulting electricians and engineers for a number of the most important submarine cables, and on several occasions he visited both North and South America in his professional capacity. His scientific aid was also in much request as a juror in international exhibitions. He was juror in physical apparatus at the London Exhibition of 1862, in the engineering at the Paris Exhibition of 1878, and in electricity at the Health Exhibition last year. Much of his success in carrying on scientific projects in foreign countries was due to the fact that he was a highly accomplished linguist. German, French and Italian were almost as familiar to him as his mother-tongue, and he was quite at home in the French drama and literature.

Within the last few years Prof. Jenkin had devoted much of his time to the "telpherage" system, which is just on the eve of a practical commercial application.

Commencing with the year 1859, Prof. Jenkin wrote a large number of papers on scientific and social subjects, as well as several text books. Among the latter his "Electricity and Magnetism" is perhaps the most popular, ranking as one of the best existing elementary treatises on the subject. This book has gone through many editions, and has been translated into several foreign languages.

Apart from his scientific achievements, Prof. Jenkin was in many ways a man of remarkable power, and even more remarkable variety, being an accomplished linguist, a litterateur, a critic, a metaphysician, and a fine sportsman. He leaves a widow, the only daughter of the late Mr. Alfred Austin, to whom he was married in 1859, and three sons, the eldest of whom, Austin F. Jenkin, has had a distinguished career at Trinity College, Cambridge.

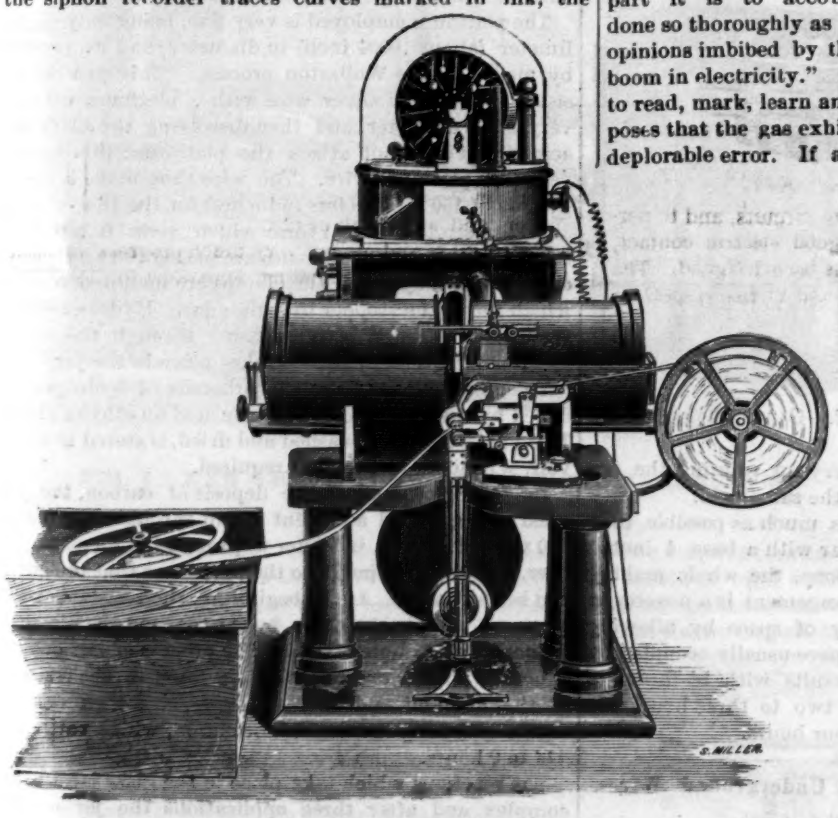
A Foreign Criticism of Western Union.

Messrs. A. P. Turner & Co., of London, have gotten out a pamphlet reviewing the financial condition of the Western Union Telegraph Company. The analysis covers the report of the company for the year ending June 30, 1884, at which time the stock and bonded debt of the company was $85,944,032. The average capitalization per mile of poles is put at $602 and per mile of wire $191. Messrs. Turner state that recently the Pennsylvania Railroad Company has erected a new telegraph line which cost $135 per mile of poles and one wire, and $35 per mile for each additional wire. The deduction from this is that the Western Union property could be reproduced at less than one-third the capitalization it represents, while "the plant would be new, with consequent minimum charges

for repairs for some time to come." One of the principal points of interest in Messrs. Turner's analysis is in the amount of expenses for maintenance and reconstruction, $1,350,488, which they claim is only three or four times as much as should have been expended. That not less than $3,000,000 must annually go into a floating debt or construction account. The Western Union Company on June 30, 1884, says the report, had no floating debt, but it admits a "construction account," into which must have gone the $4,157,469 surplus which appears in the reports of previous years, as well as the surplus for the year ending June 30, 1884.

Siphon Recorder Used on the Mackay-Bennett Cables.

For those engaged in the ordinary electrical pursuits the currents observed manifest their power very sensibly and in such a manner as to accomplish work of a greater or lesser magnitude. Outside of the laboratory among the delicate instruments employed for practical purposes, the telephone may be ranked with the foremost. Its sensitiveness is such that it is often used as an indicator to determine the balance of the Wheatstone bridge, and often in practical tests for detecting leakage of current. But sensitive as the telephone is, it is far outranked by the recording instruments used in connection with submarine cables. Our readers who followed the articles on submarine telegraphy which appeared during 1884 in these columns, will have observed, if they did not know it before, that the signals were transmitted by means of the varying electro-static condition of the cable, and not by the actual make and break of a current. This change of condition, however, produces a current of the most minute quantity, which can only be recorded by delicate instruments. Sir William Thomson's reflecting galvanometer was first employed for this purpose, but it has been gradually displaced by his siphon recorder, which possesses the advantage that it gives a visible record of the signals transmitted. A telephone placed in the circuit during the transmission of cable signals gives not the slightest indication of a current, yet the siphon recorder traces curves marked in ink, the amplitude of which can be varied to any extent, although in actual practice three-eighths of an inch is quite sufficient.



SIPHON RECORDER.

The instrument with which such beautiful results are obtained is shown in the accompanying illustration. It is that employed on the new "Commercial Cables" of Messrs Mackay & Bennett. The operation of the instrument, as is well known, depends upon the mutual action between a coil and a magnet. Thus, if a coil be suspended with its plane axial between the poles of a magnet, a current passed through the former will tend to place it in an equatorial position; and the motion thus obtained can be employed in moving a stylus for marking the change of position.

In the accompanying illustration the two large horizontal cylinders are the powerful electro-magnets, between which is suspended an elongated coil of about 500 ohms resistance. In one form of the apparatus these electro-magnets are replaced by strong permanent magnets. In front of the magnets will be seen a frame carrying a stretched wire. The latter acts as a support for a fine glass tube bent in the shape of a siphon, the upper end of which dips into a trough of ink, the lower end facing the recording tape. This delicately-balanced siphon, from which the instrument takes its name, is connected to the movingcoil by a fine thread, and thus every movement of the former is transmitted to the latter.

At the top of the instrument there is mounted a static electrical machine of the mouse-mill type. This machine is employed to electrify the ink, which spurts out of the siphon against the paper in fine drops, so that the curves traced are made up of a series of fine dots.

The speed obtained with the instrument through the cables, the shore end of which runs from New York to Canso, a distance of over 500 miles, reaches 25 words per minute, a rate which taxes the operator to keep up with. When we consider the nature of the impulses, this speed is remarkable, and bears testimony to the excellent quality and condition of the cables.

Electricity or Gas—Which?

Since the brilliant triumph achieved by electricity at the Franklin Institute Exhibition, in Philadelphia, last fall, our gas friends have evinced an unmistakable soreness and a desire to retrieve their lost ground. The *American Gas-Light Journal* of a recent date publishes a strong editorial on the coming "Novelties" Exhibition, the purpose of which can be inferred from the following extracts: "Here, it seems, is a chance for gas-men to make a comparative showing against electricity, and we do not believe that such another opportunity will soon occur again. In no other branch of the industrial arts has more progress been made of late years than in that of the improved application of gas for purposes of illuminating, heating, motive power, etc. * * * Already, we are glad to say, applications for space are coming from manufacturers of gas apparatus at home and abroad. In the department of illumination it is expected that competition will be especially warm. The Siemens, the Lowe incandescent, the Albo carbon, and many other gas-burners are now on the list, and the electric lamps are as numerous as usual. Many new and interesting features are looked for in the apparatus for heating and cooking, and in the recent devices for utilizing gas in some of the finer industrial work. * * * We hope the gas fraternity will not be slow to appreciate this occasion. * * * We believe that gas can put electricity to shame in nearly all directions of efficiency and economy; and we urge upon those in whose power it lies and whose part it is to accomplish that, to see that it is done so thoroughly as to effectually change the ideas and opinions imbibed by the public mind during the recent boom in electricity." Here is something for electricians to read, mark, learn and inwardly digest. If any one supposes that the gas exhibit will not be a good one he is in deplorable error. If any one thinks that electricity will necessarily be triumphant in 1885, just because it made a magnificent display in 1884, he is laboring under a still worse delusion. The present leads and must lead the past. In mechanics, business, art, science, pleasure, literature and politics this rule holds good. No army vanquishes its opponent, no party elects its candidate, no boyish nine wins its game, solely by the prestige of past achievements. Work is necessary in all cases, and bygone glory is to present exertion what pictures are to solid food. If the electrical interests put forth sufficient energy they will surpass their rivals; but if the contest lies between languid electricians and wide-awake gas men, the meter will get the best of the dynamo. We trust that our electrical friends will make a good showing at the Novelties, and thus retain, as they can, the laurels won in 1884.

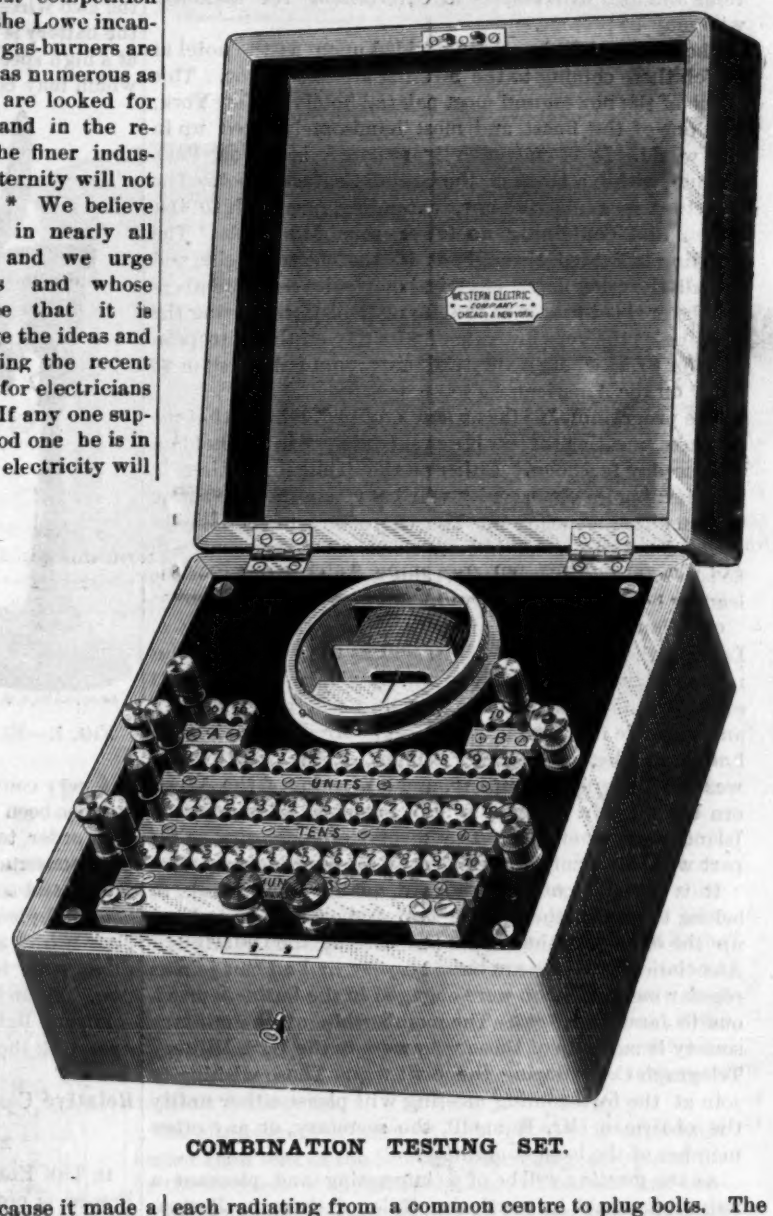
Long Branch Telegraph Offices.

The telegraph business at Long Branch is good in the season, and worth looking after. Hence the Baltimore & Ohio Company has made an effort to get some of it, but is met by the strong opposition of the Western Union Company. On June 26, a temporary injunction was served upon D. H. Bates, President of the Baltimore & Ohio Telegraph Company, and John J. Rogers, proprietor of the United States Hotel at Long Branch, restraining the Baltimore & Ohio Company from maintaining a public telegraph office in that hotel or excluding the Western Union Company therefrom. The writs were made returnable on Tuesday, June 30, at Trenton, N. J., before the Vice-Chancellor. The Western Union Company asks for a permanent injunction against the Baltimore & Ohio on the ground that the contract made last year between the Western Union and the United States Hotel gives the company a right to renewal from year to year if it so desires, unless 90 days' previous notice of a desire to discontinue or annul the contract is given by the proprietor of the hotel.

Landlord Rogers declares that his understanding of the contract leads him to believe that it expired on Sept. 15, last year. The Baltimore & Ohio Company has opened a temporary telegraph booth on the lawn in front of the United States Hotel for the accommodation of the public. The booth will be maintained until the case is settled, or at least through the summer season. The Baltimore & Ohio rates between Long Branch, Asbury Park, Red Bank, Deal Beach and Ocean Grove and New York and Philadelphia have been reduced from 25 to 15 cents for ten words.

"Western Electric" Combination Set.

Our illustration represents an apparatus in the devising of which the special aim has been to supply the wants of inspectors of electric light, telephone, fire alarm, and other circuit wires. The apparatus, which comprises a Wheatstone bridge, rheostat, and galvanometer, is compact and light. It contains a zero galvanometer of great sensitiveness and a bridge having coils of 10, 100 and 1,000 ohms each radiating from a common centre to plug bolts. The latter are so disposed as to be readily connected to the extent desired by the insertion of a single plug on each side of the bridge.



COMBINATION TESTING SET.

The rheostat ranges from 1 ohm to 11,110 ohms, and is capable of measuring from .01 ohm to 1,000,000 ohms, or 1 megohm. The resistance is made up of ten 1-ohm coils, ten 100-ohm coils and ten 1,000-ohm coils, each row being provided with a single plug that is moved to the right or left to insert or remove resistance from the circuit. Two keys are conveniently placed in the front part of the box, and serve to close the battery and galvanometer circuits. As the name indicates, the apparatus is made by the Western Electric Company. The whole is mounted on a vulcanized rubber top and inclosed in a black walnut case.

New Britain, Conn.—Although the birthplace of one of the most prominent electric light companies, New Britain was until June without the light itself. The local company then formed adopted the Schuyler system. To show the city what the light was, they put up as illustrations some 14 street lamps in different parts of the city. In one locality especially where the nightly brawls had disturbed the neighborhood for years, the brilliancy of the light was too great and the roughs dispersed. The city has contracted for all of the fourteen lights and petitions already presented point to an immediate increase of fifty more.

Reunion of Old Telegraphers.

At the annual meeting of the Old-Time Telegraphers' Association, and of the Society of the U. S. Military Telegraph Corps, at St. Louis, in August, 1884, the members of each spent a very pleasant time together. The Committee of Conference, appointed by the two bodies, fixed upon New York City as the place, and August 19 and 20 as the time for the meeting of 1885.

Western members have complained that heretofore comparatively little interest has been shown in either association by Eastern men. It was thought, therefore, that a meeting in New York would produce good results, bringing together a large number of the old pioneers, and perhaps leading to the establishment of branches of both organizations in New York.

A local committee of arrangements for both associations, composed of well-known representative New York members, was recently appointed by C. W. Hammond, president of the Old-Timers, to take charge of the preparations for the forthcoming reunion. The names of the committee are J. H. Bunnell, chairman; W. J. Johnston, secretary; A. S. Brown, W. J. Dealey, C. G. Eddy, B. Ely, C. C. Hine, J. Van Horn, Col. R. J. Gilmore, J. Merrihew, W. P. Phillips, M. H. Redding and W. B. Somerville.

The members of the committee are actively at work, having already held several meetings. They are much gratified in having succeeded in making specially advantageous arrangements both as regards hotel accommodations and also with respect to entertaining the members who may be present.

The Murray Hill has been decided upon as the hotel at which those coming to the meeting are to convene. This is one of the newest and most palatial hotels in New York, and one of the finest and most handsomely fitted up in the world. It is conveniently situated, being on Park avenue, within a block of the Grand Central Depot. The structure is a massive one, extending from 40th to 41st street, and containing no fewer than 548 rooms. The building is lighted throughout by the electric light, and has all the other latest electrical conveniences. Members will be enabled to stay at the Murray Hill Hotel during the meeting at the very low rate of $1 a day on the European plan (or $1.50 where a very elaborate room is desired) or $3 a day on the American.

The programme, so far as now outlined, will be that the business meeting of each organization will be held on Wednesday forenoon. Either at that time or earlier in the morning an opportunity will be given those wishing to join either association. The afternoon will probably be devoted to sight-seeing in New York. The banquet will be served at eight o'clock the same evening, at one of the leading hotels at Coney Island.

On Thursday the wind-up meeting will take place. Later in the day the members will be the guests of Commodore Erastus Wiman, who will provide a steamer and refreshments at his own expense and will give the party an enjoyable trip around New York. Mr. Wiman is well known to telegraphers as President of the Great Northwestern Telegraph Company, and a Director of the Western Union. Mr. Wiman is also President of the Staten Island Ferry Company. This display of generosity on his part will be warmly appreciated by the old-timers.

It is the duty of all who are qualified, we think, to belong to one or other of the two bodies, and so to keep up the old associations. In the case of the Old-Timers' Association, the dues are but $2 a year, and all can join as regular members who were engaged in the business previous to January 1, 1863. The membership of the military society is made up of those who were in the U. S. Military Telegraph Corps during the civil war. Those wishing to join at the forthcoming meeting will please either notify the chairman (Mr. Bunnell), the secretary, or any other member of the local committee.

As the meeting will be of so interesting and pleasant a nature, it would be worth the while of those in Boston, Philadelphia, Baltimore, Washington and other cities near by, intending to join the organization, to make up special parties for the occasion. There are a great many old-timers in the large Eastern cities, who are eligible and should become members, and each of these cities should send a strong delegation.

The Bankers & Merchants' Company Reorganized.

A new company, called the United Lines Telegraph Company, has filed its certificate of incorporation in the New York County Clerk's office. The capital stock is $10,000, in 100 shares of $100 each, and the incorporators are: John Anderson, twenty-five shares; Edward S. Stokes, of the Bankers & Merchants' Telegraph Company, twenty-five shares; Alfred Sully, twenty-five shares; Alexander H. De Haven, five shares; Dwight Townsend, five shares; Benjamin Allen, five shares; Horace Stokes, five shares; Henry A. Tappin, five shares, and George Turnbull, five shares. The general route of the lines covers all points in the United States and Canada, and by cable to any point on the coast of Ireland, Penzance and London, England, Brussels in Belgium, and Paris, France. The company may also connect by line or incorporate into their own system any other telegraph company existing in the United States.

By a three-fifths vote of the Board of Directors the capital stock can be increased, and preferred stock may be issued giving the holders a preference as to dividends and otherwise. The directors, by a like vote, may also convert bonds and other securities issued by said corporation into common or preferred stock. The shareholders may also authorize the Board of Directors to purchase, lease or acquire all property, rights, privileges and franchises of any character, or interest therein, and may also purchase any or all shares of the capital stock of any other corporation and give in payment money, notes or bonds and stock of their own corporation. The articles of association may be amended by a three-fourths vote of the directors.

This company has been organized with a view of purchasing the entire interests of the Bankers & Merchants' Telegraph Company and carrying out and increasing their business.

The Iceberg Electric Fan and a New Battery Jar.

The approaching hot weather has stimulated some of our manufacturers of electrical goods to apply the convenient electric current to cooling purposes. The "iceberg" electric fan shown in the accompanying engraving is now being put on the market by the Messrs. Stout, Meadowcroft & Co., of this city. It stands 14½ inches from the base to the top of the fan, and consists of an iron base with brass upright, upon which is placed a small electric motor, having attached a highly-finished 9-inch brass fan. There are two binding-posts in the base, to which are attached the two wires leading from the battery to the fan. When the battery is attached, the fan revolves almost noiselessly at a high speed, and throws out a continuous cooling breeze which may be felt plainly as far as 10 to 12 feet away.

FIG. 1.—ELECTRIC FAN.

FIG. 2.—GLASS BATTERY JAR.

A very convenient form of battery for running the fan has also been recently devised by the same firm.

In order to economize space as much as possible, they have constructed a glass battery-jar with a base 4 inches square and containing two partitions, the whole making one solid piece of glass. This arrangement is a novelty in glass-work, and affords economy of space by allowing three cells to be made in the space usually occupied by two. These batte ies give good results with bi-chromate solution, lighting a lamp from two to three hours and operating the electric fan about four hours.

Relative Cost of Overhead and Underground Wires.

BY DAVID BROOKS, PHILADELPHIA.

In THE ELECTRICAL WORLD of Nov. 15 last, Mr. W. H. Preece is credited with the following statement: "We know how much it costs us to maintain the wires over ground. We know that if we have more than 15 wires, we go under ground because it is cheaper. That has proved to be the case in England, and we put our wires under ground because it is cheaper than to go over ground." Again he says: "I don't think there is an engineer, however competent he may be for designing underground work in England, who is not equally competent to design underground work on this side of the water. Why it is you have delayed the solution of this question with you so long, I cannot make out." Mr. Preece, on several occasions in his speeches in this country, gave us plainly to infer that the reason we did not construct our wires under ground was on account of the incompetence of our electrical engineers.

It has been stated that there are three hundred repairmen employed in New York city alone, at an average expense of $2.50 per day each, aggregating an outlay for the maintenance of overhead wires in that city the snug sum of seven hundred and fifty dollars per day; or, counting 300 working-days for the year, an annual expense of two hundred and twenty-five thousand dollars. This sum is the interest, at 6 per cent., on three million seven hundred and fifty thousand dollars. Counting the cost of burying the wires at one hundred dollars per mile per wire, this would bury thirty-seven thousand five hundred miles of wire, or far more overhead wires than New York city contains. I have not the statistics giving the correct number of miles of overhead wires in New York, but the companies themselves must have the data, and if they will construct underground wires where as many as fifteen can be brought into one route, they will certainly find an immense saving in the expense of maintenance.

Suppose they borrowed the money for this underground construction, and paid interest at 6 per cent. on the sum borrowed; they would save a much larger amount in repairs, and the difference would enlarge their dividends.

There is no earthly reason why the works I have just completed in New York should not last for fifty years. The system has been in use for two years in Philadelphia without interruption or extra expense. Of the advantages of underground, uninterrupted wires it is not necessary for me to speak. That they work infinitely better than overhead wires, being free from inductive disturbance and cross talk, any one can satisfy himself by testing the wires in this city, where they will have a continued length under ground of over five miles.

The Cruto Incandescent Lamp.

Among the incandescent lamps at the Philadelphia Electrical Exhibition, the "Cruto," of French manufacture, though not in operation, attracted attention on account of the high claims of efficiency made for it. The construction of this lamp is peculiar. The main object, as in others, is to obtain a filament of the greatest possible homogeneity. The method employed to effect this is quite original and is described in a recent number of our French contemporary, *L'Electricien*. M. Cruto builds up his filament little by little, and thus obtains a carbon of great density, the pores of which are as small as possible.

The process employed depends upon the fact that certain hydro-carbons are decomposed by heat, and their carbon deposited upon the heating surface. This is the method usually employed for standardizing carbon filaments, as they come from the carbonizing furnace.

In the present instance the carbon is deposited on a core of platinum raised to incandescence by the passage of a current while in the midst of a hydro-carbon gas.

The platinum employed is very fine, being only $\frac{1}{10}$ millimeter (about .0004 inch) in diameter, and is produced by means of the Wollaston process. This process consists in drawing a silver wire with a platinum core to a very small diameter, and then dissolving the silver in an acid which does not attack the platinum; this leaves a very fine platinum wire. The wire thus made is cut into lengths of 150 millimeters (6 inches) for the 16 c.-p. lamps, and then stretched on a form which gives it a U shape. After this the ends of the wire are placed in two clamps in circuit with a dynamo; the clamps are mounted on a base which forms the stopper to a glass jar. Hydro-carbon gas is admitted through a tube passing through the stopper, and the deposition of carbon takes place in the jar.

The gas employed here is bicarbonate of hydrogen, produced by the action of sulphuric acid on ethylic alcohol. This gas, after being washed and dried, is stored in a reservoir, whence it is drawn as required.

In order to produce the deposit of carbon, the jar is filled with gas, and a current is sent through it, of about 150 volts E. M. F.; in order to protect the filament, however, a rheostat is put into the circuit so that the current can be regulated. At the beginning, the resistance of the platinum wire is 350 ohms, but at the end the filament is reduced to 150 ohms. During the process a curious fact is noticed; at the end of five or six minutes the resistance of the filament suddenly increases, and then decreases regularly during the time of formation, which varies from 1½ to 2 hours.

The reactions which take place in the glass jar are very complex, and after three applications the jar must be cleaned. This becomes necessary on account of the deposit of carbon which settles on the walls of the jars and prevents any observation of the interior. As the deposit of carbon proceeds, the interposed resistance is gradually diminished, and the gas renewed from time to time.

The current has, in addition, a mechanical action on the platinum wire; thus, a repulsion of the two branches of the loop is observed, and a tendency to take up a certain cardinal position. In order to avoid this tendency, the two sides of the loop are placed in the plane of the magnetic meridian. If the loops become crossed during the operation, they are brought back to their original position by reversing the direction of the current.

The filaments so formed are then inserted into the platinum ends forming the terminals of the lamp, and cemented to them by a similar deposition of carbon. This process, it is claimed, gives a most dense and homogeneous filament, and the efficiency of the lamps, according to published accounts, exceeds that of the other lamps which have thus far come into general commercial use. The process is an ingenious one and could be applied in more than one way.

Effect on Beet Seed.—It has been observed by Professor Holdefleiss that beet seed sown in a pot in which the soil was exposed to the electric light germinated two days earlier than similar seed without the action of the electric light. Another interesting observation is that of Herr Scholler, who has noticed an exceptional luxuriance of beets in a small plot which had been struck by lightning.

Analytical Balances.

The present age is peculiarly one of investigation and research in the field of science pure and applied. More than ever the determination is evinced to measure and weigh all things, and to resolve them into their constituent elements, and hence it becomes necessary that the expert should be furnished with apparatus the most trustworthy. There has of late years been marked improvement in American appliances for delicate test work, and to-day we illustrate one of the most creditable productions of the kind.

Becker Brothers, successors to the well-known firm of Becker & Sons, were awarded at the New Orleans Exposition six first-class gold medals for their various balances and weights of precision, including the medal for the best and most complete exhibit in their line. Their business was originally carried on at Brussels, Belgium, and Rotterdam, Holland, but in 1875 it was transferred from the latter place to this country; the works now being located at New Rochelle, New York, and the wholesale and retail store in New York city. They manufacture all kinds of balances and weights of precision and all sizes of the same; but the class to be particularly described at present is that which is especially adapted for use in all minute electrical and chemical measurements. The term

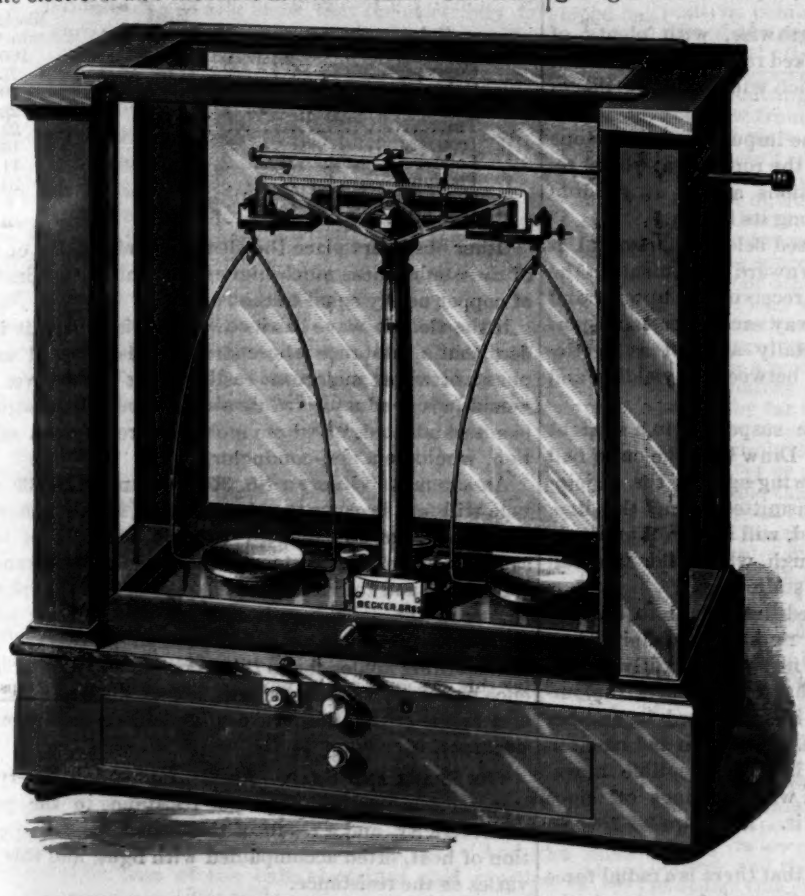


FIG. 1.—NEW SHORT BEAM ANALYTICAL BALANCE.

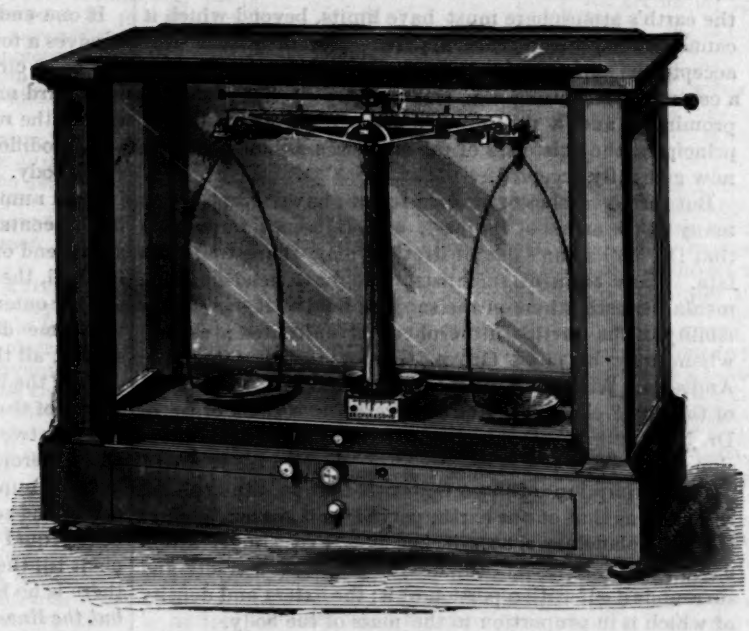


FIG. 2.—ANALYTICAL BALANCE, LONG BEAM.

"analytical" has heretofore been applied to indicate special use in analyzing chemicals and ores; but the electrician at present finds almost as many uses for these fine balances as do the chemist and the assayer. For instance, he can determine the weight and specific gravity of carbon filaments for incandescent electric lamps; he can calibrate electrical instruments with great accuracy by weighing the amount of electrolytically deposited metal separated by a unit of current; he can determine the coefficient of electrical resistance of pure copper wire and other metals per unit of weight; he can investigate the effects of magnetism and electricity upon the specific gravity of iron and steel; he can establish the relations existing between the various electrical units and those of weight; in short, he can employ the balance for all those purposes which require either accurate or rough weighing in connection with his laboratory work. As a familiar example of the sensitiveness of these balances, it may be stated that a piece of human hair, one-sixteenth of an inch long, was found to weigh, by repeated trials, the 250th part of a grain. Such an example is sufficient to prove that the workmanship is of the highest order and that the qualities are the best that could be desired.

Two general classes of instruments are shown in the cuts. Fig. 2 is analytical balance No. 7, such as may now be found in general use for scientific purposes all over the world. Fig. 1 is a new short beam analytical balance, provided with a newly invented attachment which is claimed to increase the efficiency and accuracy thirty per cent., and Fig. 3 is a general view of a set of analytical weights of a hundred gramme piece down to one milligramme and three riders, accepted by the United States Government as standard. By means of the new form of balance, the rider, by which the final minute adjustments are effected, may be manipulated from the outside, in such a manner that it can be moved from one end of the graduated beam to the other by means of a single rod provided with two lifters, all of which is clearly shown in Fig. 4. Instruments of precision are best appreciated by actual inspection of the workmanship, and, more especially of their operation under test experiments. These instruments are used by the United States Government in scientific departments and coast survey offices, for the adjustment of standard weights, and they are generally preferred by the scientific professors of our leading colleges for educational laboratory use and for scientific investigation.

The new invention as described is the occasion of this article, and certainly deserves the consideration of all interested in analytical scientific research, and in practical minute weighing of articles for any purpose whatever. All the balances that are provided with the invention, the firm prefer to construct with a short beam so that the weighing may be accomplished more rapidly.

Mackenzie Indicator.

One of the usual complaints against electric bells is that no means exist of knowing whether the bell has rung when the push button has been pressed. Several attempts have been made to overcome this defect, but none of sufficient simplicity and cheapness to warrant their general introduction.

Recently Messrs. Woodhouse & Rawson have brought out the Mackenzie Indicator, designed for the purpose of giving a verification of the signal sent. The apparatus consists of a soft iron core fixed to an iron base, and surrounded by a bobbin of wire, which forms part of the circuit upon which the appliance has to be used. An iron box is placed over this electro magnet, having its lid close to the end of the

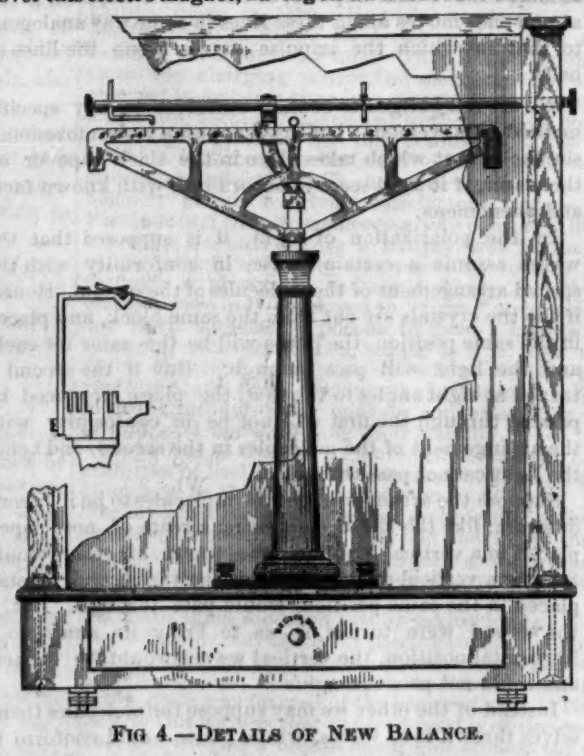


FIG 4.—DETAILS OF NEW BALANCE.

core. Upon the current flowing round the bobbin, the core and the lid, being the respective poles of a continuous magnet, become magnetized with opposite polarities and emit a sound; the make and break action of the bells, however, immediately comes into play, and the core and the lid, losing their magnetism, again emit a sound which continues to be given out as long as the current is passing.

This is the well known "Page effect" made use of practically. The action being solely molecular no moving parts are needed, and there is therefore nothing to get out of repair. Being an audible instead of a visual indicator, its use is not restricted to any place where light is required, while its sound is capable of being increased to any desired amount.

The small appliance can be inclosed within the push-button, and occupies very little more space than those ordinarily used. For many purposes where a verifying signal is requisite the indicator will prove of value, giving, as it does, a clue to the condition of the line and the working apparatus.

Incandescent Lighting by Primary Battery.

The Kauffer-Goldner system, which is on exhibition at 51 State street, Boston, is notable as a very successful attempt to preserve constancy in a high-tension battery. At that place Messrs. Kauffer & Goldner are running three

FIG.3.—SET OF WEIGHTS.

candle-power lamps with ten cells of this new battery. The constancy is obtained from a new depolarizing solution, the ingredients of which have properties as to solubility and as to depolarizing power which are said to be superior to those of bichromate of potash. On account of this great advantage Messrs. Kauffer & Goldner say that they are able to make as strong a solution as they wish, as there is no chrom-alum formed on either positive or negative electrode, and the battery always remains as clean as when first set up.

The electriomotive force of this battery is somewhat higher than that of the Bunsen, this being accounted for by the strength of the acid solution. The cells are constructed of sufficient size to furnish the necessary current for the three lamps as well as the lasting power. The zinc is inclosed in a porous cup, containing free mercury at the bottom, and thus amalgamation prevents local action. The positive pole, the carbon, is in the depolarizing solution, about ½ inch from the porous cup; thus making a low-resistance battery. The cells are built square and when put in a box will not take up a space more than 2 feet square. The lamps are run in multiple arc, and are of 15 volts, ¾ ampère, 8 candle-power each.

An important feature of this system is the regulation of the light. If the user has too much light, he is enabled, by moving a little switch, conveniently disposed, to increase or decrease the intensity of his light, while at the same time he is saving his fuel. The firm claims that the battery is always ready for use. All one has to do is to turn the "cut-out" to obtain the light.

There is no consumption of material when no light is produced. The depolarizing solution is cheap, and the light can be produced to compare in price with gas, at $2.50 per thousand feet. The battery is warranted to run from four to five hours a day for six weeks, without alteration, and at the end of said time the replenishment of the depolarizing solution is all that is necessary, as the consumption of zinc is so small that the rods will last six months at the above rate. One battery which has been set up for five weeks is now running daily from four

to five hours, and it seems to be as strong and constant as ever. A clock mechanism is being made which will automatically record the time that the battery has been in use, thus enabling the firm to rent the light if they find it expedient to do so.

Static Electricity.

BY PHILIP ATKINSON, A. M., PH. D.

CHAPTER III. (*Concluded.*)

THE NATURE OF ELECTRICITY.

THE WAVE THEORY.—It has been assumed that a subtle medium, termed *ether*, pervades all space; that it is so attenuated that it can insinuate itself between the grosser molecules of material bodies; so that solids of the finest and closest texture, as well as liquids and gases, are pervaded by it; and that light, and probably electricity, are due to waves or undulations of this ether.

The evidence of the existence of such a medium is almost wholly negative, and like all negative evidence, unsatisfactory. The assumption presupposes the necessity of its existence.

It has been stated that energy is a universal property of matter, and the converse may be accepted, that energy cannot exist without matter. And since light, coming from the sun, must traverse the inter-planetary spaces, there must be matter there; else we shall be compelled to admit that energy can exist without matter, which is contrary to all our experience.

The earth is surrounded by an atmosphere, to the limits of which no mortal has ever penetrated. In 1822, Dr. Wollaston made a careful mathematical calculation, as the result of which he claimed to have demonstrated that the earth's atmosphere must have limits, beyond which it cannot exist. And this apparent demonstration was accepted as authority, and remained unchallenged for half a century. Meantime the wave theory of light became prominent, and a medium being one of its fundamental principles, the existence of the ether was assumed, and is now generally accepted.

But the researches of modern science have swept away many of the errors of the past, and it is not impossible that Dr. Wollaston's demonstration may share the same fate. Many eminent scientists, who have made experimental investigations on the subject, hold that the expansibility of the earth's atmosphere is unlimited; among whom may be cited Grove, Gassiot, Geissler and Dr. Andrews. And W. M. Williams, in his work, "The Fuel of the Sun," claims to have discovered a serious error in Dr. Wollaston's calculations, which vitiates his conclusion.

The assumption of these writers is that an atmosphere, the same as that of our earth, pervades all space; that in the inter-planetary spaces it becomes exceedingly attenuated; and that each of the heavenly bodies attracts and surrounds itself with a portion of it; the extent and density of which is in proportion to the mass of the body.

The high degree of vacuum which can now be attained by improvements in the air-pump, seems to demonstrate that while electricity will pass more freely through rarefied air, on account of the reduced resistance, than through air of ordinary density, it must still have a medium in which to travel, and that its passage through an absolute vacuum, or space devoid of any known material substance, is highly improbable.

But as the best attainable vacuum is still only an approximation to an absolute vacuum, the full demonstration of this point has not yet been reached.

The existence, then, of some elastic medium by which the two forms of radiant energy known as light and heat can traverse the inter-planetary spaces is not questioned. Nor does the theory of the unlimited expansion of our atmosphere conflict at all with the theory of the universal existence of ether, since the theory of ether is that it permeates all material substances.

The wave theory assumes that radiant energy is transmitted by the undulations of some medium; that an impulse originating at any centre of energy, as the sun, produces a wave which traverses this medium with inconceivable velocity till it reaches some distant point, as the earth; and that the constancy of such impulses at every point on the sun give rise to the phenomena of solar light, heat and electricity.

In like manner we may assume any other centre of energy, as a red-hot metal ball, radiating light and heat; a stick of ebonite, excited by friction, radiating electricity.

It is also assumed that the impulses radiate in straight lines while the undulations occur at right angles to those lines.

To illustrate: drop a pebble on a smooth sheet of water; the impulse creates waves which radiate outward in widening circles. The pebble has depressed the water at the point where it struck, forcing the adjacent water outward, and causing it to rise above the general level; then the downward impulse of this wave, sinking under the force of gravity, raises the original centre, and also produces, by its outward impulse, another wave beyond, as it descends by its inertia below the general level.

As the water oscillates vertically above and below the level, each successive impulse produces a new wave, while the same process goes on in the outward waves, creating new waves beyond, in ever widening circles, till the force of the original impulse has been exhausted, and the water returns to its original level.

Now, it will be perceived that there is no transfer of the water from the centre outward beyond the length of the first wave. Part of the water forced outward by the original impulse flows back again, while another part flows outward, producing a new wave. The water then is under the influence of two forces, one horizontal, the other vertical, acting at right angles to each other, the horizontal producing the wave length; that is, the distance from crest to crest, or from hollow to hollow, while the vertical produces the height, that is, the vertical distance from hollow to crest, or from crest to hollow.

In a similar way, it is supposed, occur the undulations of the assumed elastic medium, with this exception, that the waves on the water occur in the same horizontal plane, radiating outward in concentric circles, while those in the elastic medium occur in any direction in which they are free to move, radiating outward in concentric spheres, if wholly unrestrained, or in sections of spheres or spheroids if limited, and starting from impulses at various points on any surface, either sperical, like that of the sun, or plane.

Having taken an illustration from a liquid, illustrations from solids will also be in point.

If a long rope, stretched lengthwise, with plenty of slack, be held at one end, and jerked rapidly up and down, it will be thrown into waves, which will run along its entire length.

Here it is evident that while the impulses given at one end travel in waves to the other, the rope, as a whole, remains stationary; successive portions acting as yielding levers to transmit the impulse along its length.

If one end of a lever be depressed below a horizontal, it receives a forward as well as downward movement, in the arc of a circle, its opposite end receiving an upward and backward movement. In this way each successive portion of the rope oscillates horizontally as well as vertically, modified by the difference between a yielding and rigid body.

Let a number of elastic balls be suspended in a straight line in contact with each other. Draw back the outer ball at one end of the line and let it swing against the adjoining ball, the impulse will be transmitted along the line, and the outer ball, at the other end, will swing off to nearly the same distance as that through which the first ball swung, all the others remaining stationary.

Here the impulse is transferred from ball to ball by virtue of their elasticity. When number one impinges on number two the impact changes its shape slightly to that of a spheroid; as it resumes its shape it imparts the impulse to number two, by which it is imparted to number three, and so on through the line. But action and reaction being equal and opposite, there is no perceptible movement till the last ball is reached, which swings off since there is no ball to react against it. *The impulse travels, but the line remains stationary.*

Here, also, it will be perceived that there is a radial force acting at right angles to the horizontal force much the same as would result from a similar impact if each ball were hollow and its surface composed of an infinite number of semicircles joined at the points of impact.

Now the molecules of a metal rod may be compared to an infinite number of these lines of balls; and it may be assumed that a heat impulse, or an electric impulse, given at one end, moves along these lines in some way analogous to that in which the impulse moves along the lines of balls.

We are not obliged to confine ourselves to any specific method of movement; but may suppose a wave movement, similar to that which takes place in the slack rope or on the water, if it shall seem to accord best with known facts and phenomena.

In the polarization of light, it is supposed that the waves assume a certain phase, in conformity with the special arrangement of the molecules of the crystal. Hence, if the the crystals are cut from the same block, and placed in the same position, the phase will be the same for each, and the light will pass through. But if the second is turned at right angles to the first, the phase produced by passing through the first will not be in conformity with the arrangement of the molecules in the second, and hence the light cannot pass through.

Suppose the arrangement of the molecules to be in layers, or strata, like the sheets composing a ream of note-paper, placed in a vertical position; the waves of ether would assume a vertical phase, and, meeting the second crystal, placed in the same position, would pass through. But if the second were turned, so as to bring its strata to a horizontal position, the vertical waves would be broken, and could not pass through.

Instead of the ether we may suppose the molecules themselves thrown into waves, whose phase would conform to the structure of the crystal, and the same result would evidently follow.

There is no reference, in this supposed case, to any visible stratification of a crystal, as the experimental ray is usually admitted at right angles to such stratification; the reference is to an invisible arrangement of the molecules.

The same course of reasoning is applicable to heat or to electricity, but the phase of the heat wave or the electric wave may be different from that of the wave of light, so that a substance opaque to light, as copper, might allow the free passage of heat or electricity; or a substance transparent to light, as glass, might obstruct their passage.

And the medium in which the electric energy travels may be the ether which is supposed to pervade the different kinds of matter; or the matter itself in any of its various forms, solid, liquid or gaseous: as it has been shown that undulations may take place in each of them.

CONDUCTIVITY FOR HEAT AND ELECTRICITY COMPARED. It is very remarkable, and must be something more than mere coincidence, that conductivity for heat and electricity is nearly the same in the same substances. A good heat conductor is a good electric conductor; a non-conductor of heat is a non-conductor of electricity. So that if we know either the conductivity or resistance of any substance for heat, we have, practically, its conductivity or its resistance for electricity. This will appear from the table given below, showing the results obtained by Wiedmann and Franz.

Hence, if heat and light are modes of motion, traversing various substances by undulations, we are warranted in assuming the same with reference to electricity.

COMPARATIVE CONDUCTIVITY of different substances for heat and electricity, as given by Wiedmann and Franz:

Substance.	Heat conductivity.	Electric conductivity.
Silver	100	100
Copper	74	73
Gold	53	59
Brass	24	22
Tin	15	23
Iron	12	13
Lead	9	11
Platinum	8	10
German silver	6	6
Bismuth	2	2

Other observers place the electric conductivity of some of these substances much higher, making the conductivity of copper nearly equal to that of gold.

If the electric wave has its own peculiar phase, it is evident that a substance whose structure is adapted to that phase, or whose molecules easily adapt themselves to it, would be a conductor; while a substance whose structure is not so adapted, or whose molecules resist such adaptation, would be a non-conductor.

An attempt to insert a No. 36 screw into a No. 30 screw hole will fail, because the threads, that is, the *phases*, of the screws, are not adapted to each other. But let the same screw be inserted into some yielding substance, as soft wood, and the substance adapts itself to the phase of the screw; or, as we say, it cuts its own thread; while a rigid substance like iron resists such adaptation.

Something analogous to this may constitute the difference between conductors and non-conductors, and may also be the cause of other electric phenomena of equal importance.

THE SPARK AND SNAP.—As already stated, every substance offers a certain degree of resistance to the passage of electricity, and a result of this resistance is the generation of heat, often accompanied with light, and this effect varies as the resistance.

Platinum is a metal of high resistance, while that of copper is very low; and a fine platinum wire will be brought to a white heat by an electric current which would scarcely change the temperature of a copper wire of the same size.

Air offers such high resistance that the passage of electricity through it always produces both heat and light in the form of a bright spark. This occurs not only when an electric charge passes through several inches of it, but through the thinnest film, the presence of heat, as well as light, being demonstrated by the lighting of gas by a spark less than one-eighth inch in length.

A sudden condensation of the air, forced forward and laterally by the charge, has been suggested as the probable cause. If such condensation takes place, heat would certainly be the result, as when air is compressed by mechanical means. And, perhaps, it would be accompanied by light, though this is not probable, as combustion and incandescence are the only known means of producing artificial light, besides that now under consideration, either of which would imply the presence of some other substance besides air.

But the hypothesis seems to assume the passage of some material substance through the air to produce the condensation, of which there is no evidence.

But if, instead of condensation, we suppose undulations to take place giving great intensity of motion, as the electric impulse, darting forward with inconceivable velocity, suddenly forces the resisting air into the phases of the electric waves; then the generation of those other modes of motion, known as heat and light, might easily be the result.

A sharp sound, varying from an insignificant snap to a deafening report, always accompanies the spark. On the condensation theory this is accounted for by the sudden displacement and reflux of the air. But since sound, like heat and light, is another mode of motion, occurring chiefly in the air, it is evident that the wave theory will best account for it; the electric impulse giving rise to all these different modes of motion.

THE DUAL THEORY.—We have already seen, in experiments with the pith ball electroscope, that the balls may be attracted and repelled by electrified glass, sealing wax, and various other substances.

Let an electrified glass rod approach one of the balls; the ball is attracted, and, after contact, repelled. Now let an electrified stick of sealing wax be brought near, and the electrified ball, which was repelled by the glass, is attracted by the wax. Or, let the ball be first electrified and repelled by the wax, and it is attracted by the glass.

Further experiments show that the same results can be produced with other substances; glass representing a certain class of substances, which show similar electrification, and sealing wax and resin another class, which shows opposite electrification to that of glass.

Hence it has been assumed that there are two kinds of electricity. One kind generated on the class of substances represented by glass, and the other on the class represented by resin. The former was once designated as *vitreous*, and the latter as *resinous*; but the term *positive* is now used instead of vitreous, and *negative* instead of resinous.

Used in this way, these terms have no reference to a difference either in quantity or intensity; they express only a supposed difference in *kind*, not in *degree*.

This doctrine of the dual nature of electricity was first proposed by Dufaye, and has since been strongly maintained by many eminent scientists. Deschanel, speaking of the phenomena under consideration, says: "These phenomena clearly show that the electricity developed on the resin is not of the same kind as the electricity developed on the glass."

Now the only thing "*clearly shown*" is the difference in the *substances*, not in the *electricity*. For we have precisely the same electric phenomena of attraction and repulsion with the glass as with the sealing-wax; but a third substance, the electrified pith ball, is attracted by one and repelled by the other; a result which it would seem more reasonable to attribute to the difference *known* to exist between the *substances*, than to a difference *supposed* to exist in the electricity.

For it has already been shown that different causes, as conductivity or resistance, influence the intensity of electrification on different substances. Other causes also, as a difference of temperature or mass, of hardness or softness, density or porosity, doubtless contribute to the same result.

But, considering the quality of resistance alone, the potential of any non-conductor, as glass, is liable to vary greatly on different parts of its surface, when electrified by friction; and to differ from the potential of sealing-wax, similarly produced on different parts of *its* surface.

The friction of the same rubber is also greater on a substance like sealing-wax, whose surface is soon softened by the heat generated, than on a smooth hard substance like glass, which is not affected in this way.

And, as already shown, difference of potential produces attraction, while equality of potential produces repulsion between bodies. Hence the attraction by the sealing-wax, of the pith ball electrified by the glass, is a necessary result of difference of potential; while its repulsion by the glass follows from equality of potential. And the same will be true of the ball electrified and repelled by the wax and attracted by the glass.

But if a difference exists in the kind of electricity produced by the different classes of substances, we should expect that difference always to manifest itself whenever one of either class is employed as a generator.

But this is only true in a general way, to which the exceptions are very numerous; for it often happens that glass and sealing wax, or other substances belonging to the different classes, when rubbed with the same rubber, exhibit the same electric qualities. The same result also will often follow where different kinds of rubbers are employed; as silk on one substance and woolen on the other.

Such results are inconsistent with the theory of two electricities; but are easily accounted for by a difference, or an equality of potential, which we know is liable to exist.

Hence, preference must be given to the doctrine of *one* electricity, originally proposed by Franklin; simple and plain, like truth itself, and in strict accord with all electric phenomena; whether pertaining to static electricity, or to electricity under other forms.

(TO BE CONTINUED.)

A Complimentary Review.—In speaking of our reprint of the proceedings of the National Conference of Electricians, the *Mechanical World* says: "There are very few of the applications of electricity which were not more or less exhaustively discussed by such men as Professors Sir W. Thomson, S. P. Thompson, E. Thomson, Forbes, Houston, Rowland, Nipher, Abbe, Trowbridge and Newcomb; and Messrs. Keith, Preece, Sprague, Lockwood, Jewell and others. These names are sufficient to show that on the questions submitted the total of existing knowledge was brought to bear. Among the subjects discussed were: Atmospheric electricity and earth currents, dynamos, electric units, transmission of energy, telephony, telegraphy, secondary batteries, standard of light, underground wires, measurement of current, the physical condition of metals, and last and least, a new unit of power. The publisher of this compact and useful reprint has followed his usual laudable custom of producing the work at the lowest possible price, so as to make it generally accessible; but at the same time he has been careful not to sacrifice to economy the qualities of type and paper."

Secondary Batteries.*

BY FRANK GEERE HOWARD, STUD. INST. C. E.

The earliest form of accumulator was a voltameter worked backward, and was first observed in 1801 by the French chemist, Gautherot. Two years later Ritter, in Germany, carried out a number of experiments in the same direction, and endeavored to utilize the reaction; he employed for this purposes two plates of gold, separated from each other by flannel kept moistened with acid, and charged by an ordinary Volta's pile. If two pieces of platinum be immersed in diluted sulphuric acid and connected to the two poles of a battery, so that a current be sent through them, the liquid will be decomposed, hydrogen being given off at one plate and oxygen at the other. If then the battery be disconnected and the plates circuited through a galvanometer, it will be seen that they give out a current in the opposite direction to the charging current.

Becquerel first pointed out the real cause of the returned current, upsetting the original theory that the plates absorbed the current during the charging, and gave it up again during the discharge. He showed that the returned current was not due to the storage of electricity, but to the presence of substances having chemical affinities for each other, derived from the decomposition going on during the charge.

If two sheets of ordinary lead be placed in dilute sulphuric acid, and a current be sent through them, a dark brown deposit will form upon the plate connected to the positive pole of the charging battery, due to the formation of the peroxide of lead on the surface of that plate, while the other will be reduced slightly to spongy lead. Upon disconnecting these plates from the charging source, and circuiting them through a galvanometer, a current will flow from the brown or peroxidized plate to the other reduced plate.

The result is the reduction of the peroxide of lead on the one plate to oxide, and then to sulphate of lead from the presence of the sulphuric acid in the solution; and of the spongy lead to sulphate of lead. Upon recharging, the anode or brown plate attached to the positive pole of the charging source will again become peroxidized, and the cathode or other plate reduced to spongy lead. The sulphate of lead will thus disappear from both plates. The plates are thus continually oxidized and deoxidized as they are charged and discharged.

This is a secondary battery in its simplest form, and all accumulators are based upon this principle. Lead has proved by far the best metal for the purpose, because it forms an almost insoluble oxide; a few other metals are nearly insoluble, but lead has the advantage. It is better than silver or manganese for the reason that its oxide is less soluble than either of them.

The initial electromotive force of a freshly prepared cell when charged is 2.25 volts, but this drops after the first few minutes of the discharge to a little less than 2 volts, which may be taken as the normal electromotive force of a cell made up of peroxide of lead, spongy lead and dilute sulphuric acid. The constancy of the electromotive force of a cell varies considerably with the rate of discharge. If it is run down or discharged at a very rapid rate it falls off very quickly; whereas if only a small current be taken out the electromotive force will remain constant for a long time, though the loss on the negative plate or anode from local action will be greater. The strength of the electrolyte or solution varies considerably during the charging or discharging of the cell. When the cell is fully charged the solution is strongest, and when discharged weakest. From this point it follows that the internal resistance of a battery is lowest when the electromotive force is at its highest, and the converse. Dr. Frankland has endeavored to utilize this change in the specific gravity of the solution, to indicate the condition of the cell, and has found that a change of 0.005 in the specific gravity was equal to a storage of 20 ampère-hours. This method of determining the state of the cell does not in practice give very good results, on account of the difficulty of getting the solution in the cell to circulate freely, so as to be of the same density throughout.

The first practicable form of accumulator was that of Planté, made in 1860. He took two sheets of lead, and, placing them in dilute sulphuric acid, passed a current through them for some time. Then disconnecting the cell from the charging source, he discharged it, and again charged it, but this time in a reverse direction; so that the lead plate, formerly connected to the positive pole of the charging source was this time connected to the negative pole. A number of charges and discharges were thus alternately effected until the plates were rendered sufficiently porous to give a satisfactory storage capacity. Planté found that it was necessary to continue this process for some months before a battery was fit for use. Of course, when the battery was used the current was sent through it always in the same direction. The reverse charges were only employed to "form" the plates, or render them sufficiently porous to hold a charge. Unfortunately, this form of cell, simple as it is, does not store much electrical energy, except when very thin plates are employed, and these soon become brittle and liable to fall to pieces through being entirely converted into peroxide of lead, and thereby losing their stability.

According to Géraldy a Planté cell containing 1.445 kilogrammes of lead is capable of storing 4,983 kilogrammetres of energy, or 11,329 foot-pounds per lb. of lead. De Meritens modified the Planté cell by making the plates out of a number of thin sheets of lead laid one upon the top of the other, and soldering their edges together, thus obtaining plates composed of a number of layers of thin sheet lead.

Kabath again modified this by taking long thin strips of lead which he corrugated by passing them through grooved rollers, and then interleaving them with plain strips, or ribbons of lead, folding them backward and forward, until a plate was formed of the required size. The drawback to this form is that the lead used is of necessity very thin, and thus soon breaks down and renders the cell useless. In both these cases the same tedious process of forming as in the Planté cell has to be gone through.

In 1880 Faure devised the plan of pasting red lead or minium upon plates of plain lead; this paste was rapidly peroxidized and reduced in one charge, thus overcoming and doing away with the long process of forming the Planté plates. The paste had to be held on the plates by wrapping them in flannel or some such porous material. This increased the internal resistance of the cell, and after a time the flannel began to get rotten and fall off, causing the cell to fail. A much higher storage capacity, however, was obtained, it being 18,000 foot-pounds per lb. of lead and minium. Many improvements have been introduced by Messrs. Sellon and Volckmar, culminating in the form now manufactured by the Electrical Power and Storage Company, which consists of grids of cast lead with holes from ¼ to ¾ inch square.

The grid used for the anode is made thicker than that for the cathode. These castings are filled with a paste of minium and dilute sulphuric acid. After being dried they are placed in long troughs, filled with dilute sulphuric acid, and a current is sent through them to form them. The amount of current necessary to convert 1 lb. of minium to peroxide is 70 ampère-hours, and 140 ampère-hours to reduce it to metallic lead. But as it only needs 110 ampère-hours to reduce 1 lb. of litharge, this is generally employed for the cathode plate. After the current has been sent through the plates, they are taken out, washed, and stacked until required for use, when they are mounted in their respective cells, and employed for lighting or other purposes. No felt is put between these plates; they are separated from each other by India rubber bands, pieces of wood, or some similar device.

The storage capacity of this cell is considerably higher than that of the Faure type, being 48,000 foot-pounds per lb. of lead. But since the storage capacity of a theoretically perfect secondary battery is 360,000 foot-pounds per lb. of lead, even the best cell falls far short of this. The figures in Table I. against Sellon-Volckmar are the results obtained from cells specially constructed for driving electric launches, tram cars, etc. Those employed ordinarily for lighting purposes yield about 36,000 foot-pounds per lb. of lead.

TABLE I.—STORAGE CAPACITY OF THE VARIOUS SECONDARY BATTERIES AS REGARDS RATIO OF WORK TO WEIGHT.

NAME.	Storage capacity in foot-lbs. per lb. of lead.	Percentage of efficiency.
Theoretical perfect cell	360,000	100.00
Sellon-Volckmar	48,000	13.13
Compton-Fitzgerald	24,000	6.66
Faure	18,000	4.99
Planté	12,000	3.33

It has been proposed by Mr. Fitzgerald to substitute carbon for the lead employed for establishing contact with the active material of the cathodes, where oxides of lead are used, and also to protect parts of the anodes by means of some insulating material, so as to arrest the process of peroxidation over the whole of the plates, and thus always to preserve a good contact throughout the anode. A large number of experiments have been carried out in this direction. The best results obtained were from a battery made up of cathodes composed of minium and carbon fragments, held in a punctured lead envelope, and anodes composed of spongy or finely-divided lead, also held in a punctured lead envelope, and protected by a network of insulating material, generally known under the name of Prout's glue. This form had a storage capacity of 24,000 foot-pounds per lb. of lead. Messrs. Beaumont and Biggs's battery is made up of plates of compressed spongy lead. The lead is obtained in this state by precipitation from a solution of acetate, or sugar of lead, in which solution is placed a plate of zinc. Lead, in a state of very fine subdivision, si deposited upon the zinc, from which it is scraped off, put into molds, and subjected to hydraulic pressure. By this means plates of great porosity are obtained, which should have as high a storage capacity as any known form of battery. Of the numerous batteries in the market, nearly all are modifications of the well-known Planté type, which seems to be the best form for durability, if not for storage capacity; and the "life" of a battery is of far more importance than its storage capacity per lb. weight. The most notable battery of this class, and one coming prominently into notice, is manufactured by the Wolverhampton Electric Light Company, called the Elwell-Parker accumulator. The plates of this battery are made of sheet lead only, but before being formed they are immersed in a strong solution of nitric acid, which attacks the surface of the lead, and honeycombs it to a certain extent. Thus, according to Planté, who first patented this process in 1881, the long process of forming is to a great extent done away with. There seems, however, to be considerable doubt whether this is the case, or if the nitric acid simply dissolves the lead. In all probability the acid attacks the impurities in the lead, and thus prepares the plate in the best possible manner to receive the current. Another battery is the B. T. K., so called from the names of the inventors, Messrs. Beeman, Taylor and King. This is a modification of the Kabath accumulator, consisting of plates made of alternate corrugated and plain strips of lead, wound round and round upon themselves.

An improvement by Dr. Frankland is claimed upon the Sellon-Volckmar type of battery, by hardening the paste of minium, or other oxide of lead used in the plates, by immersing the plates in solutions of sulphuric acid of various densities during different periods. He also claims for the plates the capacity of receiving a higher rate of charge. This hardening mixture may be cast into plates or cylinders of any desired form or size. There are also many other batteries of the Planté type by various inventors. Mr. Joel has patented a plate having a considerable storage capacity. He makes the plates of lead-wool, or perhaps more properly speaking, lead fibre, mixed with minium, and then pressed upon a cast-lead plate which acts both as a conductor and support.

The advantages of accumulators made after the Planté type over those of the Faure type are that they afford a far higher rate of discharge. This property is invaluable for many purposes, as, for instance, where numerous lamps are required to be run for only a short time. But then, again, accumulators of the Faure type take in a higher rate of charge than the Planté, because they have a greater thickness of working material, and also store a larger amount of electrical energy in a given weight.

The durability or life of a secondary battery has never been satisfactorily settled. Manufacturers assert that their accumulators will last for a number of years, but this has not yet been proved. Those of the Sellon-Volckmar type cannot, the author believes, be depended upon to last more than five or six months at the outside when they are worked regularly every day up to their full capacity. But when overcharged continuously, or otherwise

*This communication was read and discussed at a meeting of the students of the Institution of Civil Engineers on Jan. 16, 1885.

mproperly used, a few days will often suffice to put them out of order.

The Planté accumulator should last longer than this, but it must be borne in mind that when this battery has arrived at its maximum of efficiency it is on the point of falling to pieces. Where water or steam power is available, a rough, but serviceable battery may be made by taking sheets of thick lead, cutting them into plates of any required size and mounting them in tanks filled with dilute sulphuric acid. Of course during the first few charges the storage capacity will be very small, but this will improve every day. At the same time, the cost of forming them is next to nothing. Eventually it will prove to be a most efficient battery.

The first and most important point in setting up a secondary battery is to carefully insulate the cells from each other, and from any moisture. This is best effected by arranging them on wooden shelves raised about 8 inches off the floor, and at an equal distance from the walls. The boxes should be left with a space of at least an inch between them, and, wherever possible, placed in single rows, and not upon shelves one on the top of the other, so that free access may be had to each box. In large installations the cells are often of considerable size, weighing from 5 to 6 cwt. each, thus rendering it extremely difficult o move them. For these reasons they should be so arranged that, once put up, they can be easily got at for repair without being removed. The importance of keeping the cells perfectly free from moisture can hardly be overrated. If they should be placed upon a damp floor, or in any position where moisture can get to them, there will be a considerable leakage of electricity, the cells will rapidly run down (*i. e.*, become discharged), and will be, in all probability, condemned as unworkable and useless.

All secondary batteries, when first set up, should be tested for insulation. This may easily be done by connecting one pole of the battery (after it has been charged) to one terminal of an ordinary galvanometer and the other terminal of the galvanometer to earth. The best way to obtain a good earth is to connect the wire to a water or gas pipe; or if neither of these should be available, to drive a piece of iron into the ground and make a connection in that way. If the needle is deflected it indicates leakage, which should at once be remedied. The leakage will in all probability be found to arise from an escape of the solution from one of the cells, the place where they are standing being damp, or one of the leads "making earth." The poles of the cells should be connected together by stout bars of metal. It is inadvisable to use copper on the positive pole of a cell, on account of the rapidity with which it corrodes. Plain lead connections or a mixture of lead and antimony are the most trustworthy. The positive pole of one cell is joined to the negative of the next, and so on all through the series. Then the positive pole of the dynamo is connected to the last positive of the battery, and the negative to the negative. The contacts must be properly made between each cell, as a bad contact will produce a great deal of heat in the cells, thereby introducing resistance into the circuit and reducing materially the rate of charge or discharge. Care should be taken not to charge the battery at too rapid a rate, and if at any time during the charging the cells become warm, the charging should be stopped, and the battery allowed to cool down. The heating of the plates causes them to buckle, often resulting in the short-circuiting of the cell, and thus putting it out of use until the defect has been remedied.

During the charging, and also while they are at rest, it is advisable to test the cells from time to time. This may be readily done by taking a short length of stout wire, holding one end upon one pole of the cell to be tested, and striking the opposite pole with the other end of the wire. If the cell is in good condition, it should give a bright, crisp spark. If it gives no spark at all, it shows that there is a short circuit in the cell, arising, in all likelihood, from two of the plates touching each other, or from a small piece of some conducting substance having fallen down between the plates. This should be at once remedied, otherwise the cell should be cut out from the circuit and taken to pieces. It is very important, when working batteries, to keep all the cells in as even a condition as possible; for if a cell be empty, or is discharged before the others, it will then be recharged in the reversed direction, and thus set up an opposing electromotive force to the rest of the battery; besides, there is the risk of spoiling that particular cell. Keeping all the cells in the same condition is best effected by observing them when charging, and cutting out of the circuit all those cells that give off gas freely, and continuing to charge the others until they are all fully charged. If this is done about once in two months, the working efficiency of the battery will be maintained at a very high point. Of course, this entails extra labor, but the author contends that secondary batteries do, and always will, require skilled supervision. Care must be taken not to cut out too many cells while charging the battery without introducing a corresponding resistance, or the dynamo will be burnt.

The ordinary strength of the electrolyte is 1 part of sulphuric acid to 9 parts of water, or of a specific gravity of 1·2; that of sulphuric acid being 1·84. The water should be as pure as possible. When working a battery it is necessary to keep all the plates immersed in the electrolyte. If it becomes necessary to add to the electrolyte to keep the cell full, water only should be used, otherwise the solution will become too strong. When batteries are left out of use for any length of time, it is advisable either to remove the solution and wash the plates and boxes with water, or else to leave them fully charged. This latter method is perhaps best adopted only when the battery is not to be out of use for very long. It is found that when batteries are left idle and full of the solution, sulphate of lead will form all over the plates, and have a serious effect upon their future working.

By discharging a cell too rapidly as much harm can be done to it as by charging it too rapidly.

The best dynamos for charging accumulators are shunt dynamos. Both the series and compound machines are liable to have their poles reversed by the batteries discharging through them, which is liable to arise from the speed of the dynamo decreasing, and thereby having its electromotive force overpowered by that of the battery. This difficulty might be overcome by specially designed automatic switches. The most economical way is to charge each battery in two series in parallel, though, of course, while charging them in this manner, no lights can be run at the same time. The circuit should be so arranged that the dynamo is charging the battery in two series in parallel, or in one series with the lamps in parallel, or dynamo, lamps and battery all in parallel. In order to charge an accumulator, it is necessary to employ a dynamo giving an electromotive force greater than that of the cells, and greater than in proportion to the rate of charge required; but as all excess of electromotive force is lost energy, a slow charge is the most economical where time is of little moment.

The uses to which accumulators may be put are almost endless. They are serviceable for almost every application of the electric current. Lighting being at present the most in need of them, by employing an accumulator in any installation, the failure of the light should be rendered almost impossible.

The employment of secondary batteries for driving trains, tram-cars, boats, etc., has been a good deal discussed, but up to the present time, although many costly experiments have been undertaken, no practical work has been done.

The main reason why electricity has not yet been employed for motive power for boats and tram-cars is, the author thinks, undoubtedly to be traced to the still imperfect and unsatisfactory state of secondary batteries. When once they have been so far improved as to be looked upon as trustworthy, a great and lasting impetus will certainly be given to the utilization of electricity, for motive power as well as for lighting purposes.

A Few Powerful Lamps.

To the Editor of The Electrical World:

SIR: Now that the Statue of Liberty will soon be erected, I agree with you that some scheme for lighting it should be seriously considered. It appears almost superfluous to remark that none but the electric light can be employed to advantage for that purpose, but how best to arrange it seems to me no easy problem. After mature consideration I humbly submit the following plan as one which, in my estimation, will give satisfactory result:

Let there be six powerful lights placed around the torch, thus practically adding to the effect of the symbolic emblem of the "Enlightening" of the world. To these ought to be added a number of lamps at the foot of the statue, at the front, sides and rear. These would illuminate all parts of the statue and pedestal and bring the figure out in good relief. LUX.

Put Arc Lights at the Top and Bottom.

To the Editor of The Electrical World:

SIR: Allow me to encroach upon your valuable space with a suggestion in regard to the illumination of the Bartholdi Statue. In my opinion the statue should have as much light as possible thrown upon it, and so that all parts are equally illuminated, in order that the statue can be seen far and wide, as it should be. To that end I would place a number of powerful arc lights on the torch; then a number of lights ought to be arranged all around the base of the pedestal and the base of the statue. These latter lamps I would provide with reflectors so that all their light is spent to good purpose, though they are hidden from actual view; the latter for the additional reason that the observer's vision would not be dimmed, as would be the case were the lamps not so protected. I am of the opinion also that a few lamps placed in the diadem of the figure would greatly heighten the effect. If anything better than this can be suggested, I should like to know it.

"LIBERTY."

Incandescent Lamps Required.

To the Editor of The Electrical World:

SIR: As nothing definite concerning the lighting of the great statue of "Liberty Enlightening the World" has as yet been decided upon, I avail myself of the opportunity which you offer for the discussion of the subject. I am of the opinion that the statue could be very well lighted by incandescent lamps. These would obviate the unsteadiness of the arc lamp due to the inevitable vibrations which must ensue, and another decided advantage would be the fact that no daily renewal of carbons would be necessary, an operation at all times troublesome, and which might in stormy weather prove dangerous in this case.

All this would be obviated by using incandescent lamps, which could be distributed evenly so as to give a uniform illumination.

I would also suggest that this method of lighting would make it easy to bring out vividly the inscription "4TH JULY, 1776," on the tablet held by the statue. The letters could be easily traced by large incandescent lamps, so that the legend would be even more distinct at night than in the day-time. W. H. B.

Telephonic Interrogatories.

To the Editor of The Electrical World:

SIR: Please answer, through the columns of your valuable journal, the following questions:

1. What are the conditions on which so many patents are issued on telephone transmitters wherein the variation of the resistance of carbon is the principal feature? In other words, why are patents issued to Drawbaugh and others for carbon transmitters when Edison is the *first* inventor and patentee?

2. What are the conditions on which patents on magnetic receivers are issued to other parties since the invention of Alexander Graham Bell?

3. Is there any operative form of telephone relay in use by which the voice can be relayed into another line successfully?

4. Is there any practical form of loud-speaking magnetic telephone in use—loud enough to be heard by an entire audience of several hundred persons?

HANFORD, Cal. SUBSCRIBER.

ANSWER.—1 and 2. These patents are granted in accordance with the usual condition of *novelty*. 3. We know of no such relay in use. 4. Our issue of March 28 contained an illustration and description of Dr. Ochorowicz's loud speaking magneto telephone, which, used in connection with his new transmitter, is said to have allowed speaking, singing and music to be heard throughout the hall of the Paris Geographical Society, which accommodates 500 persons.

The Jenney Companies.

To the Editor of The Electrical World:

SIR: Although such controversies are not to my taste, justice requires that some notice be taken of the communication from Brainard Rorison in your issue of June 20. If he will examine the archives of his company he will find that his total stock of patents consists of one for a defunct clutch never used by anybody, and the undivided half of the patent issued to Jas. A. and Chas. D. Jenney, which he describes as worthless. James A. Jenney, of the Fort Wayne Electric Light Co., is the father, not only of the Jenney system of electric lighting, but of the "electrician" of whom Mr. Rorison's company is "possessed." We bade the young man God speed when we discharged him from our employ, and we wish him now all deserved success with his new relations. The world is big enough for us all, and there are better ways to rise than by clawing others down.

But Mr. Rorison is attempting to sail his company into favor under false colors, and upon the reputation made by the Fort Wayne company. To his preposterous claims we oppose our simple denial; for acts of like character we shall seek a different remedy, if occasion shall arise.

R. T. MCDONALD, Treasurer,
Fort Wayne Jenney Electric Light Co.

FORT WAYNE, Ind., June 27.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, July 1, 1885.

Mr. Gray, of No. 50 Sudbury street, this city, is making a dynamo, which he claims to be entirely new in principle. If Mr. Gray's dynamo possesses what he claims for it—that is, gives an increase of power at an enormous saving of fuel—it will prove an invaluable adjunct to electrical industries, and will yield the maker a handsome fortune.

The new buildings recently erected by the Edison Electric Lighting Co. on Columbus avenue, this city, are a credit to the enterprise of that well-known corporation. In a few days everything about the new plant will be in working order. This will give the company largely increased facilities for filling the orders pouring into their Boston office. Messrs. Paine & Stickney, the Boston agents of the Edison Co., are two of the busiest people in New England. The company, Mr. Paine says, are about installing a large plant (600 lights) at Woburn, Mass.

The Tropical Telephone Company are shipping 40 sets to the Guatemala Telephone Company, which will give them altogether 150 subscribers.

The Bell Telephone Co. declared on June 25 an extra dividend of 2 per cent., their regular quarterly dividend of $3 per share having been declared on the 20th instant. The *Financial Chronicle* says of Bell telephone and the telephone business: "We may remark, however, that too little notice has been taken outside of Massachusetts of the financial importance of the telephone. Boston is the headquarters of the Bell Company; most of the stock is owned in that neighborhood, and the shares are dealt in only at the Boston Stock Exchange. Owing partly to the manner in which the stock of the company was originally disposed of, the fluctuations in price are almost as wild as a mining stock when San Francisco is crazy over a bonanza or a collapse. That is to say, there are a great many weak holders who are easily frightened, but their holdings are very small. The market has sometimes advanced nearly 40 points in a single afternoon on sales of less than 100 shares, and sometimes again a determined seller has depressed the market several points on a sale of less than a share, on an average, to a point. That is not a way to recommend a stock to the public, certainly. But it must be evident to all who have been interested in the developement of the telephone business, that there is a great future for that business, and that immense fortunes will be built upon it, as upon railroads and telegraphs. Of course, too, there will be great losses. Hitherto Boston has had a monopoly of both. Those who have been most successful are they who foresaw the future of the invention, and bought stock in the Bell company before it reached par. They have seen their dividends increase from a modest 6 per cent. to a regular rate of 8 per cent. quarterly, with an extra dividend of 3 per cent. last year and another extra dividend of 2 per cent. this week. Possibly there is trouble ahead, both for the Bell Company and for the numerous local corporations. But they have a strong position, and cannot be easily dislodged. The foundation patent is running out, but telephoning will not be free when it expires. The American Bell Telephone Company has from the beginning adopted the policy of buying every useful patent;

and the licenses of this company will be in occupation of the territory, which is a strong point in their favor. Whether the stock of the company will ever be any less than it is now an extra-hazardous speculation, is merely matter of guess-work."

The Armington & Sims Engine Company has shipped another large engine to the Hartford Electric Light Company of Hartford, Conn., making the fourth 80-horse-power engine furnished by them to the same company.

We have recently received from Ware & Co., of Boston, one of their Telephone resonanters, a valuable attachment for the telephone. The device looks like a silver hour-glass with a dome, out of the side of which a circular piece has been taken. The bottom of the resonanter fits the wooden face of the transmitter, the openings in each corresponding.

The person talking speaks close to the hole in the dome, and the sound is concentrated on the transmitter to the great relief of the listener, as words are much more readily heard on long as well as short lines.

Messrs. Seth W. Fuller & Holtzer report business with them as very good. They have recently received large contracts for placing their electric goods in several of the leading hotels and some of the public buildings of Boston.

Their large and well appointed factory at Brookline, Mass., enables them to manufacture everything in the shape of electrical goods and at a moment's notice. They have recently been adding new machinery at their factory, for making their own magnet wire, and for the manufacture of speaking tubes, etc., etc. They have commenced the manufacture of the "Leclanché Disque Battery," and are producing it in a very handsome, durable and cheap pattern. The electric annunciators made by this firm will be found in nearly every section of the country.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, July 1, 1885.

The Western Electric Company are just in receipt of an order for a seventh multiple switchboard for Kansas City. The sixth board was put in only a short time ago, but the wants of the exchange make a seventh board necessary. The ultimate capacity of the Kansas City board is 3,000 subscribers, and the new board will make its equipment good for 1,400.

$79,880.60 is the size of the United States Electric Lighting Company's contract for lighting the county buildings—a very fair contract for the dull season, it will be conceded: 3,585 incandescent lamps are called for by the contract, as follows:

Cook County court-house	1,200
Jail and criminal court	350
County hospital	1,300
Infirmary	250
Insane asylum	485

The company have the contract for everything, including five engines. The kind of engine to be used has not yet been decided on.

Other new orders of the United States Company include 250 incandescent lights for the penitentiary at Santa Fé, N. M., and 450 incandescents for the St. Louis Polytechnic Institute.

Mr. G. W. Hebard, President of the United States Electric Lighting Company, is spending a few days in Chicago.

In making some further reference to the fire marshal's report, I note that the value of the Chicago fire alarm telegraph system and apparatus is placed in the report at $274,508.58.

The personnel of the fire alarm telegraph staff is as follows: John P. Barrett, superintendent; David M. Hyland, chief operator; John Fitzpatrick, operator; William Carroll, operator; Henry Leser, operator; Jacob F. Mehren, operator.

The following from the report seems peculiarly applicable in view of the recent arrangement between the conduit company and some of the electric light companies: "Evidences are abundant showing a large prospective increase in electric lighting during the coming year. The system of underground conduits which is just now being inaugurated will greatly facilitate and encourage the establishment of extensive central stations, from which radiating wires will enable all within reasonable distances from the generators to avail themselves of lights at far less cost and annoyance than can be possible by any other method. In addition to this, parties owning the central station can afford, and must have, the best of skilled labor in charge of the mechanical and electrical departments of the plant, to guarantee satisfaction to consumers."

The McIntosh Galvanic and Faradic Company are settling down in their new quarters at 300 Dearborn street.

Rice, Whitacre & Company are just getting used to their new building on West Monroe street. Their new accommodations are much superior to their old.

A modification of the Amet electric governor for the purpose of regulating the currents produced by dynamo electric generators has recently been perfected. The need of this device in cases where two or more dynamos are driven from one source of power is self-evident, as the steam governor can control but one dynamo or one series of dynamos on a single circuit, as it controls by varying the speed to suit the amount of current required. Mr. Amet calls his device a brush regulator, and where it is used the speed is kept constant and the point of delivery on the generator changed to compensate for any and all changes in the resistance to be overcome.

As demonstrated by the tests, a dynamo may be short-circuited at full speed without injury to the machine, and any number of lamps may be thrown in or out of circuit. The apparatus steadies the lamps, and does away with about 20 per cent. of the flickering, the lamps remaining at a normal brilliancy whether two or twenty are burning. A constant current is maintained, and all changes are instantaneously compensated for. Mr. Amet is doing some good work in the field of electrical invention.

THE TELEGRAPH.

Canadian Underground Wires.—A dispatch of June 27 from Montreal, Que., says: The Woodward Underground Telegraph Company has issued its prospectus. The capital stock has been placed at $200,000, and the plant for this city and environs at $100,000.

Direct Communication Between Brazil and the United States.—A dispatch from Buenos Ayres, dated the 26th of June, says: "Minister Osborn, acting in accordance with instructions received from the State Department, Washington, has concluded a contract securing to the Central and South American Telegraph Company a concession to establish cables between Buenos Ayres and Rio de Janeiro; and land lines between Buenos Ayres and the Pacific side, thus securing to an American company continuous and independent telegraphic communication between the United States and Brazil. The necessary decree has been signed by the President of the Argentine Republic."

The Stearns Condenser.—In the United States Circuit Court, New York, on June 26, a motion for a temporary injunction came on for argument before Judge Wallace in a suit recently begun by the Western Union Telegraph Company against the Baltimore & Ohio Telegraph Company to obtain a decree of injunction against the defendant, prohibiting it from using the duplex system of telegraphy. The particular point in controversy turns on the right of the Baltimore & Ohio Company to use the so-called "Stearns condenser." Grosvenor P. Lowrey and Edward R. Bacon appeared for the Baltimore & Ohio Company, and Gen. Duncan, Mr. Dickerson, and Mr. Buckingham for the Western Union Company. The motion will come up again on July 17.

Wages of Female Telegraphers in England.—A London correspondent, writing to the Dublin, Ireland, *Times*, says: Of the women at the London Central Telegraph Office 424 are second-class telegraphers, receiving weekly pay at 10s., 12s. and 14s., rising by 1s. a week per annum to 17s., and then by 1s. 6d. a week per annum to 27s. Of first-class telegraphers there are 192, with a salary of 28s., rising by 1s. 6d. per week per annum to 34s.; 15 assistant supervisors receive £90, and rise by £5 per annum to £110; 15 others receive a salary of £110, rising by £6 per annum to £140; the 8 supervisors receive £150; 6 of these rise by £8 per annum to £180; the two remaining ones to £225. The matron receives £150, rising by £10 per annum to £250. The daily work of the female telegrapher extends over eight hours, within the period of 8 in the morning to 8 at night.

THE TELEPHONE.

Automatic.—The certificate of incorporation has been filed at Albany of the Automatic Telephone Exchange of New York, with a capital of $500,000.

A Telephone Company Enjoined.—At Philadelphia, on the 26th ult., a decree was entered in the United States Circuit Court, granting to the American Bell and the Pennsylvania Telephone Companies a perpetual injunction restraining the Rogers Telegraph and Telephone Company, Robert Klotz and John Leukel, from the manufacture, use and sale of telephones containing improvements declared to be infringements upon Alexander Graham Bell's patents. The court appointed Francis T. Chambers master to take testimony and assess the damages coming to the plaintiffs.

A Practical Test.—In Philadelphia the Western Union Telegraph, Philadelphia Local Telegraph, and Bell Telephone companies have combined forces in an effort to give a practical demonstration of the operation of underground lines, and with that object in view have applied for permission to lay conduits on Chestnut street from Twenty-second street to the Delaware River, and on Third street, from Walnut to Vine. General Manager Plush, of the Bell Telephone Company, says it is the intention of the three corporations named to use the conduits for experimental tests, and while he is doubtful of the achievement of favorable results, the system will be given a fair trial in order to show not only that the companies have a respect for public opinion in this matter, but that they intend to make an honest effort to solve the problem of underground telegraphy, which has been so vigorously demanded.

THE ELECTRIC LIGHT.

Portland, Me.—The Consolidated Electric Light Company, Portland, Me., after trying long-stroke and quick-stroke engines for two years, have decided to increase their power by getting more Armington & Sims high-speed engines. They have recently added another one to the works.

Plant for Lima, Peru.—The Jarvis Engineering Company, No. 61 Oliver street, Boston, have shipped this week a complete steam plant for a Thomson-Houston electric light plant in Lima, Peru, consisting of two steam boilers, 50 horse-power each, two Armington & Sims engines, heater, steam pump, injector, etc.

Electric light companies and manufacturers of electric light apparatus and supplies who desire to become members of the National Electric Light Association are requested to make application for membership on or before August 1. All communications should be addressed to J. F. Morrison, President National Electric Light Association, Baltimore, Md.

How to Collect Moths.—It is stated that in the electric light station on School street, New Bedford, there is a glass case containing a collection of nearly five hundred moths, which have been collected from the globes of the arc lights about the city in cleaning and changing them. They are handsomely mounted, and only two in the whole collection are similar.

West Chester, Pa.—The company recently organized at West Chester for the purpose of furnishing electric light in the borough, have closed a contract for a plant of the Edison incandescent system, and the work of preparing a building for housing the same has been commenced. Some arc system for street light will soon be settled upon by the same company, which has a capital of $30,000.

Schuyler Lights.—The Schuyler Electric Light Company has just opened a Boston office at 28 Pemberton Square. Messrs Taft and Westerwelt, gentlemen well-known in business and social circles, have taken the management, and as the result of this move the Schuyler Company has received an order for an arc light plant for Marlborough, and several other negotiations pending promise as enthusiastic a reception for the system in Massachusetts as it has received in its own State.

Light and the Eye.—Investigation into the action of light on the retina and optic nerve, as reported in the *Chemical News*, shows some results slightly at variance with the common theory. It has long been an interesting point to ascertain the electromotive force of the retina and the nerve, and also to learn whether this was altered in amount by the action of light; and the experiments in question have led to the conclusion that the action of light is such as to alter the amount of electromotive force to the extent of from three to seven per cent. of the total amount, so that a strong flash of light, lasting the fraction of a second, produces a marked effect. A lamp held at a distance of four or five feet, and, equally, the light of a small gas flame, after passing through a depth of twelve inches of a solution of salts of copper and potash, also produce sensible effects.

Train Lighting in Germany.—Electricity has lately been tried for train lighting in Germany, at Frankfort-on-the-Main. The experimental train consisted of a first, second and third-class carriage, and a luggage-van containing a Moehring dynamo and twenty-six accumulators. The dynamo was driven by pulleys and belts from the axles of the wheels of the van at a speed of 700 revolutions per minute, when the train was running at a speed of 18 to 42 miles per hour. When the speed was less than 18 miles per hour the lamps were thrown out of circuit with the dynamo and accumulators, and fed from the accumulator direct by an automatic commutator. During the day the accumulators were charged with the lamps out of circuit. The installation cost $625, and weighed about 12 cwt. There were twelve incandescent lamps in all, and the cost of fitting up each carriage is estimated at from $15 to $20. The experiments demonstrated that the electric light is capable of lighting trains in motion and during stoppages: and the cost is estimated at about 2c. per lamp per hour. The trials continued for six weeks, and as everything was done automatically, except at starting, the attendance required was slight. The difficulty of breaking up a train and shunting on to a new line while keeping the carriages lighted, does not, however, seem to have been dealt with in these experiments.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Am. Cable, b 59, a 62; Am. District, b 22, a 26; B. & M., b ¼, a 1¼; Western Union, b 60¼, a 60¾.

Telephone.—Am. Bell, b 207, a 208; Erie, b 22, a 22½; New England, b 32, a 32½; Mexican, b 1.

Electric Light.—No new quotations.

BUSINESS NOTICES.

A Change of Name.—By the authority of the Supreme Court of this State, the New York Insulated Wire and Vulcanite Company have changed their name and title to the Okonite Company. The business of manufacturing insulated wire and cables for telegraphic, telephonic and electric light purposes, will be continued as heretofore.

MISCELLANEOUS NOTES.

A New Battery.—At a recent meeting in San Francisco, Gen. John Hewston read a paper describing an electrical invention by John C. Ludwig, of that city, the special object of which is to produce strong and efficient currents while obviating the necessity for maintaining large batteries and power-driven, mechanical generators. A small bichromate-of-potassium cell induces a current sufficient to overcome the resistance of over 5,000 miles of No. 10 galvanized wire. It is claimed that this invention will mark a new era in telegraphy, doing away with the huge batteries and dynamo machines now in use, and thus effecting a saving, as estimated, of $1,000,000 annually in this country alone.—*Chicago Journal of Commerce.*

Extracting Iron by Electro-Magnetism.—Messrs. Venest, Scott & Co., of Newcastle-on-Tyne, are exhibiting at the International Inventions Exhibition, South Kensington, a very ingenious machine for extracting iron from other substances by electro-magnetism, enabling engineers' refuse and mold borings to be utilized. The mixed material is fixed into a hopper, from which it falls upon the nearest of the two endless belts, and is taken under a disc containing electro magnets; this disc is carried on a spindle, the upper portion of which revolves against a commutator, so arranged that contact is made as each section of magnets comes over the nearest belt, and broken as it arrives over the other one. The electro-magnet thus picks up iron from one belt, and when over the other drops it, having by the cessation of the current ceased to be magnetic. By this means the iron is collected in one hopper, and the material from which it is has been extracted, in the other.

Georgia Lightning.—It would seem that Jersey lightning is not the only kind that can be drunk to disadvantage, since, if we may believe our usually veracious contemporary, the Atlanta *Constitution*, Mr. T. A. Sewell has had a deep, deep draught of the Simon Pure lightning. On Saturday, says the *Constitution*, while a thunder cloud was passing in the afternoon, T. A. Sewell, in Panther Creek, Coweta County, was struck by lightning and knocked down. His spring is about three hundred yards from his house, and for convenience he has a telegraph wire to draw water, with a carriage and bucket attached, and had just drawn a bucket from the spring and was

drinking out of the bucket when the wire was struck by lightning. The bolt ran up the wire and into the bucket, thence into Mr. Sewell's mouth, knocking him senseless for some time. His mouth inside was badly blistered. It is thought that the lightning lost its force in passing through the water, else Mr. Sewell would have been killed.

A New Secondary Battery.—The fact that sheet-lead in storage batteries decays very soon is a serious drawback to its use, and Dr. Kalischer recently described a secondary battery before the Physical Society of Berlin, in which iron was used as the anode, and a concentrated solution of nitrate of lead as the electrolyte. The iron, on being immersed in the lead solution, becomes passive and resis s corrosion in the liquid. When a current is sent through the cell peroxide of lead is deposited on the anode in a firm mass all over it. When nearly all the nitrate of lead is decomposed there is a greater liberation of gas at the anode. The development of gas is to be avoided at the beginning of the charge, otherwise the peroxide of lead, or, strictly speaking, the hydrated peroxide of lead, becomes covered with bubbles of the gas. A cathode of sheet-lead is employed, but to prevent it short-circuiting the cell by sending out lead shreds in charging, Dr. Kalischer amalgamates it, a precaution which also saves the lead from corrosion by the nitric acid left in the cell after separation of the lead. The electromotive force of this cell is about two volts to begin with, but after six hours' discharge it falls off to about 1.7 volts. On leaving the cell at rest for 24 hours it recovers some of the electromotive force lost.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JUNE 16, 1885.

Electric Tramway; Carlos Basto, Rio de Janeiro, Brazil..... 319,947

Consists of underground open channels having conducting linings, insulated properly, and elastic friction pieces working in th channels against the lining.

Cut-Out for Electric Circuits; Elihu Thomson and E. Wilbur Rice, Lynn, Mass., Assignors to the Thomson-Houston Electric Company..... 320,017

The current from the generator or source of electricity enters through the wire *C'*, and flows, as shown by the arrows, through lever *A'*, spring *T'*, post *W'*, wire *L'* to the apparatus *EE'*, then returning through *L* to *W*, to spring *T*, up lever *A* to *P*, and then through wire *C* to generator. The apparatus *EE'* is thus connected in the same circuit with the generator, and has the current thereof flowing through it.

Electric Lamp; Elihu Thomson, Lynn, Mass..... 320,018

Consists in making the two portions or electrodes of the controlling-switch or contact closing or varying device movable, one portion being made to follow the movement of the armature or other parts moving under the lifting action of the main-circuit magnet, while the other, as before, is moved by the action of the derived-circuit magnet.

Switch; Erastus Titus, Catskill, N. Y..... 320,019

Consists of a combination of levers so arranged as to dispense with all but one telephone in any given office.

Electric Locomotive; Joseph Weis, Jersey City, N. J..... 320,025

Provides a new combination and disposition of furnace, boiler, dynamo, motor and adjuncts, all located upon and carried by the locomotive itself.

Holders for Incandescent Lamps; Edward Weston, Newark, N. J., Assignor to the United States Electric Light Company, New York, N. Y..... 320,026, 320,027, 320,029, 320,030

The first, second and fourth are improvements upon his former patent of May 6, 1884, 298,142, and the third is an improvement

320,438. TELEPHONE SUPPORT.

upon the second, which consists of the combination, with a socket or holder containing contacts and having pins on its sides, of an incandescent lamp and base-carrying terminals, and having a notched flange with which the pins engage when the base is inserted in the socket.

Circuit Breaker; Edward Weston, Newark, N. J., Assignor to the United States Electric Lighting Co., New York, N. Y..... 320,028

Consists of the combination, with contact terminals, of a spring-actuated plate, a rotary spindle, guides for preventing the rotation of the plate, and a cam and a projection on said plate and spindle, whereby they engage with one another for the purpose of operating the parts to make or break the circuit.

Signal-Transmitter; John C. Wilson, Boston, Mass.. 320,032

Consists of a box or motor having a series of signaling-surfaces or break-wheels, and a corresponding series of contact-springs normally disengaged from the said surfaces, in combination with a selecting device by which any desired one of the said springs may be mechanically placed in engagement with the corresponding surface, which will transmit its signal while the others remain inoperative.

Electric Lighting Attachment for Gas Fixtures; Charles A. Hussey, New York, N. Y., Assignor of one-half to Joseph Snyder, Philadelphia, Pa.. 320,065

Consists in a clamp made in two sections connected, so as to admit of their separation to enable them to be slipped on to the stem of a gas-fixture transversely to the length of the latter, serving to contain an electric battery and coil.

Device for Preventing False Fire Alarms; Edward Jungerman, Elizabeth, N. J..... 320,068

The act of unlocking the alarm-box secures the key in said lock in such a manner that it can only be turned from the exterior of the screen in order to remove it from the lock, and when once secured therein the sender of an alarm must remain until released by parties brought to the locality by the sounding of the alarm.

Electric Car; Anthony Reckenzaun, London, Eng., Assignor to Frederick Reckenzaun, New York, N. Y.. 320,092

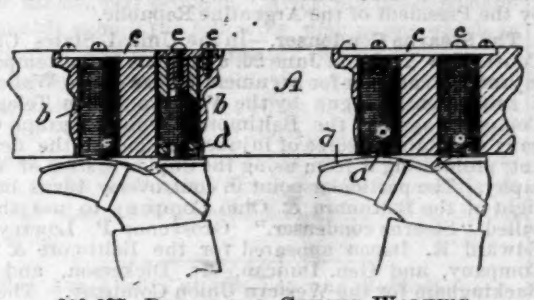
Involves a car supported by two trucks pivoted to the car and a motor upon each truck on a level with the car axles and operating the axles. The motors are operated by secondary batteries, and electric brakes are employed in an effective manner.

Apparatus for Turning on, Lighting, and Shutting off Gas by Electricity; Le Roy S. White, Waterbury, Conn..... 320,105

With the apparatus is employed a double key for sending currents of opposite polarity. When one button of the key is pressed, the electro-magnet will be energized to raise the core, and if the current be of the right polarity it will affect the movement of a small permanent magnet, which is caused to obtrude itself in the way of the core and to form of itself a positive stop or block for holding the core raised and the valve open. A pressure on the second button will send a current of reverse polarity and move the permanent magnet in a direction to allow the core to fall and the valve to close.

Electric Lamp Socket and Switch; David H. Cunningham, Elizabeth, N. J..... 320,117

Consists in an insulating-socket formed of two parts—one part to be secured to the bracket or other support of the lamp, and containing one-half of the electrical connector and

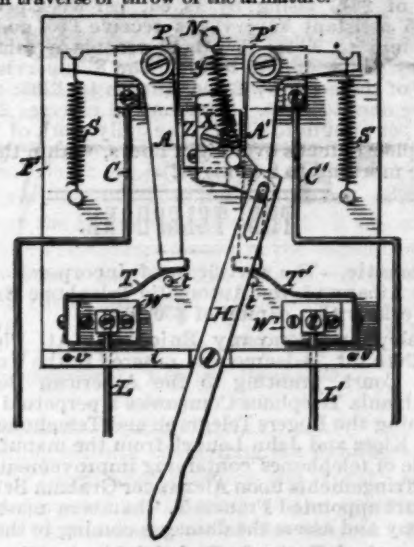


320,275. DEVICE FOR CEILING WALKING.

the switch, the other half being adapted to hold the lamp and carry the other half of the electrical connector.

Electric Engine; Charles A. Jackson, Lawrence, Assignor to the Jackson Electric Engine Co., Boston, Mass..... 320,137

Consists in the peculiar adaptation of a crank to a driving-shaft, whereby an increased length of crank is obtained with but a minimum traverse or throw of the armature.



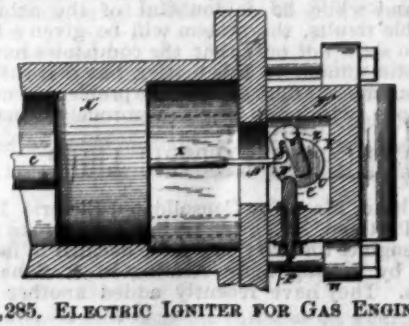
320,017. CUT-OUT.

Core for the Armatures of a Dynamo Electric Machine; Hans J. Muller, New York, N. Y., Assignor to the Zucker & Levett Chemical Co., of same place..... 320,158

Consists of a solid cast Siemens armature, provided with transverse apertures for ventilation.

Dynamo Electric Machine; José M. Revera, Buga, United States of Colombia..... 320,170

A tubular shaft is employed provided with an enlargement



320,285. ELECTRIC IGNITER FOR GAS ENGINES.

forming an oil chamber; the driving shaft passing loosely through the hollow shaft. A clutch is adapted to rigidly connect the two shafts.

Mechanical Telephone; Henry Seligman and Emma Seligman, Irvington-on-Hudson, New York; said Henry Seligman Assignor to said Emma Seligman..... 320,181

Consists in providing a supplementary diaphragm and connecting the two together.

Electric Cable; Patrick B. Delany, New York, N. Y. 320,229

Consists of the combination of conductors, insulating-buttons strung thereon, and a metallic sheath or pipe formed around the cable

Secondary Battery; James Du Shane, South Bend, Ind..... 320,232

The electrodes are provided with cellular receptacles of a helical form.

Regulator for Dynamo Electric Machines; Moses G. Farmer, New York, N. Y..... 320,234

Connected in circuit with the field magnets of a dynamo electric generator is an electric motor of any convenient construction organized to be actuated by the current employed for intensifying the field of force. A brake is applied to this motor, and the amount of retardation which it exerts upon the same is dependent upon the action of electro-magnetic device, which in turn is controlled by the current traversing the field-of-force circuit of the generator. For this purpose the coils of an electro-magnet are included in the field-of-force circuit, and as the strength of the current traversing this circuit increases, the pressure of the brake is relieved to a corresponding degree, and the motor is permitted to revolve with greater rapidity. When the current in the field-circuit is diminished, the pressure of the brake is increased, and thus the counter electro-motive force produced by the motor is decreased.

Electrical Push Button; John Geary, Philadelphia, Pa..... 320,238

Consists of the combination of a spiral spring to reset the button and two contact springs, the novelty consisting in the disposition of parts and construction of details.

Electrical Conduit and Discharger; Edmund H. Hoffmann, Newark, N. J., Assignor of one-half to Jabez Fearey, of same place..... 320,253

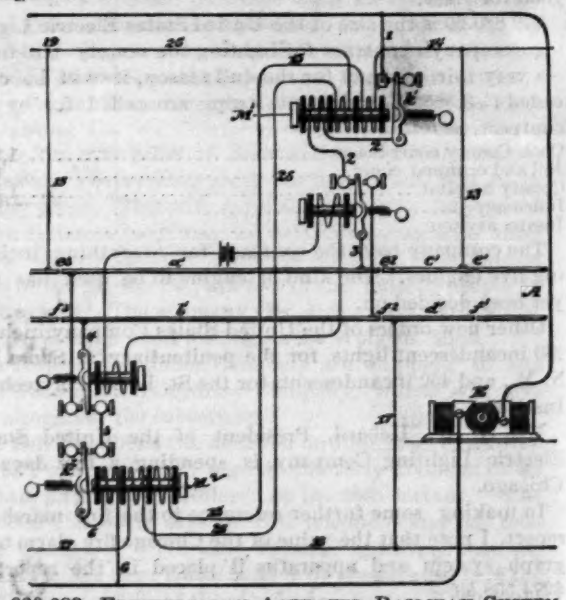
Consists in a conduit provided with man-hole chambers having a series of conductors arranged therein, and provided with fastenings or posts for the attachment of line-wires when the same are inserted in the conduit from time to time, the said conductors being provided with a discharging-wire arranged parallel thereto and connected with the ground for relieving such connected line-wires of induced currents.

Electrical Device to Enable Showmen to Walk on the Ceiling; Clyde H. Newman and William Berrigan, Rochester, N. Y..... 320,275

The invention is illustrated in the accompanying cut, the magnets being alternately magnetized and demagnetized by skillful manipulation of a cane upon switches partially concealed in the ceiling.

Electrically-Actuated Railway System; Frank L. Pope, Elizabeth, N. J..... 320,283

The operation of the apparatus is as follows: Suppose a vehicle, traveling in the direction indicated by the arrow, enters upon the short controlling-section *c' d'* at the right of the figure. The motor upon the vehicle, acting for the moment as a generator, will transmit a current through a local controlling circuit. The electro-magnets M' M^2 will now be simultaneously excited, and will at-



320,283. ELECTRICALLY ACTUATED RAILWAY SYSTEM.

tract their armatures, causing the circuit-controllers k' k^2 to si multaneously complete the circuit between the main conductor *F* and the insulated rail-section *a'* and between the main conductor and the insulated section *b'*. The main actuating current, which is thus caused to traverse the wires 2 and 6 passes through an independent helix upon the magnets M' and M^2, and thus retains the circuit-controllers k' k^2 in position after the cessation of the local current which originally caused the electro-magnets M' and M^2 to become excited. The traveling vehicle is thus supplied with an actuating current from the main conductors so long as it remains upon the section *a' b'*.

Electric Igniter for Gas Engines; Daniel S. Regan, San Francisco, Cal..... 320,285

In Fig. 2, *X* represents the projection or finger for tripping the connecting-lever. *Y* represents the connecting-lever. *Z* represents the pivot-slot in the lever *Y* to allow the same to rise, and *A'* represents the slot in the same to receive the hook *B'* upon the projection or finger *X*, which is attached to the piston-head. *K'* represents the piston-head. *N'* represents the pulley upon the main shaft, and *J'* represents the pulley upon the dynamo. *F'* represents the guides; *G'* the cross-head of the engine.

Repeater for Quadruplex Telegraphs; Thomas R. Taltavall, Brooklyn, N. Y..... 320,311

Consists of the combination, substantially as hereinbefore set forth, with a relay of a quadruplex telegraph system, of a single wire or branch circuit, means for repeating from said relay into said circuit, and means for transmitting and receiving over said circuit and at the same time repeating over or into said system.

Type-Wheel for Printing Telegraphs; Carl A. Mathiesen, New York, N. Y..... 320,376

Consists of a type-wheel having its rim cut away so as to leave a narrow foundation or support for the type, and provided with skeleton type arranged thereon, and having substantially all of the material thereof removed excepting the mere outline of the character represented thereby.

Telephone Circuit; Henry S. Thornberry, Boston Mass..... 320,414

The coils of the telephone are divided into two equal sections, one section being placed each side of the circuit, and the connections so arranged that the electrical current will pass through both sides in the same direction, causing both sections to contribute to the same result.

Telephone Support; Thomas W. Lane, Boston, Mass. 320,438

The accompanying cut illustrates the nature of the invention.